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PLAGUE ERADICATIVE MEASURES ON THE ISLAND OF MAUI, TERRITORY OF HAWAII

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GEOGRAPHY, CLIMATE, AND INDUSTRIES

The Hawaiian Islands are situated about 2,000 miles southwest of San Francisco and consist of summits of a submarine volcanic mountain chain. In addition to the commercially important islands of Oahu, Hawaii, Maui, Kauai, Molokai, and Lanai, there are a number of smaller ones of lesser importance. In area, the Island of Hawaii is the largest, with 4,015 square miles, Maui ranks second with 728 square miles, and Oahu third with 598 square miles. In population, Oahu, containing the port of Honolulu, is by far the largest, Hawaii, with the port of Hilo, ranking second, and Maui, with the port of Kahului, third. In 1935 the population of Oahu was 210,000, Hawaii 76,700, and Maui 52,200; and the total population of the Territory was 384,400.

The islands are largely mountainous, with numerous peaks, the highest of which, located on the island of Hawaii, has an altitude of 13,825 feet above sea level. The island of Maui, with which this report deals, consists of mountains in the west and east sections connected by a low isthmus 6 miles wide. The crater of Haleakala, with a rim elevation of over 10,000 feet and a circumference of 21 miles, is located in the eastern section and is a part of the Hawaii National Park. The coast line of this island is rugged for the most part, with numerous gulches emptying into the sea, except in the low central portion.

The climate of the islands is moderate, and much lower temperatures prevail than in other countries of the same latitude, owing to the almost constant northeast trade winds and the return ocean current from the region of the Bering Straits. The average mean temperature at sea level is about 75° F., with a maximum of 80° and a minimum of 70°. There is a temperature drop of about 4° in the first 1,000 feet of elevation, beginning at sea level, and an average of 3° per 1,000 feet thereafter. The higher peaks of Hawaii and Maui are occasionally snow-capped.

There is a large variation in rainfall, even between localities a short distance apart, owing to many local influences. For the island of

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Maui recorded annual figures vary from 8 inches at one station to over 400 inches at another. The station with over 400 inches is midway between Wailuku, with 30 inches, and Lahaina, with 13 inches, which are only 12 miles apart. The wettest place in the islands is at an altitude of 6,000 feet, on Mount Waialeale, Kauai, where the annual rainfall reaches 451 inches. Figures for various points in central Maui in and around the region where plague has occurred are shown in table 1. Relative humidity figures for Maui are not available, but they are probably about the same near sea level as at Honolulu, where the average is 68 percent at 8 a. m., 71 percent at 8 p. m., and 62 percent at noon.

TABLE 1.—*Average precipitation in inches, central Maui*

Month	Location							
	Kahului [1] (elevation 8 feet)	Paia [2] (elevation 180 feet)	Wailuku [3] (elevation 200 feet)	Haiku [4] (elevation 530 feet)	Puuomalei [5] (elevation 1,480 feet)	Makawao [6] (elevation 1,700 feet)	Haleakala Ranch [7] (elevation 2,000 feet)	Kula [8] (elevation 4,000 feet)
January	3.37	3.96	4.76	8.07	7.89	9.25	7.10	4.61
February	2.17	5.70	3.93	6.25	7.45	6.65	6.45	4.59
March	2.05	5.74	3.61	6.24	8.75	6.79	6.66	3.83
April	1.92	2.87	3.43	7.50	8.47	6.37	4.61	2.54
May	.94	1.83	1.35	5.17	5.17	3.99	2.37	2.52
June	.22	1.37	.51	3.86	3.40	1.35	.90	1.78
July	.38	1.68	.69	5.19	4.39	2.64	1.34	1.90
August	.43	1.95	.84	4.69	4.83	3.35	2.12	2.74
September	.43	1.77	.87	3.80	4.48	3.41	2.15	2.96
October	.95	2.43	1.17	4.33	4.71	4.17	2.15	2.18
November	1.93	4.94	2.83	6.90	8.54	6.66	5.80	2.11
December	3.54	4.09	5.02	7.26	9.38	10.36	8.02	3.92
Total	18.33	38.33	29.01	69.26	77.46	64.99	49.67	35.68

[1] Figures for 27 years up to 1924.
[2] Figures for 12 years up to 1906.
[3] Figures for 33 years to date.
[4] Figures for 19 years to date.
[5] Figures for 38 years to date.
[6] Figures for 20 years up to 1923.
[7] Figures for 42 years to date.
[8] Figures for 44 years to date.

There is a great deal of wealth in the islands, derived principally from the thriving sugar industry. On account of favorable weather and other conditions, one crop is being harvested while another is growing or is being planted. The sugarcane matures within 15 to 18 months after planting, and the yield averages 6 tons of sugar per acre. In central Maui, where the fields are irrigated, the production is as high as 12 tons per acre, and the cane stalks occasionally reach a length of 40 feet. Over 6,000,000 gallons of water per acre are used to bring a cane crop to maturity, or a million gallons per ton of sugar, and extensive irrigation projects have been installed to convey the water to the cane land. The mills produce raw sugar, which is shipped to the mainland for refining. The production of raw sugar in the Territory is approximately 1,000,000 tons per year, 20 percent of which is produced on the Island of Maui, with its four plantations and mills.

Second only to sugar is the pineapple industry, which has been developed on a large scale on the Island of Maui in recent years. Whereas sugarcane requires a great deal of water, pineapple is a desert fruit and can be grown in a much drier region. For this reason, cane is grown at elevations from sea level to 1,250 feet in central Maui to permit of irrigation by gravity, and pineapples are grown in a belt above this up to elevations of about 2,200 feet. There are four pineapple companies and four canneries on Maui. The production has grown steadily from about 1,500 cases of canned fruit in 1904 to over 2,200,000 cases in 1931, during which year about 12,800,000 cases were produced in the Territory. However, owing to an overproduction in that year, there was a marked drop in the following years; but the industry has now recovered and the demand for this product is growing steadily.

In addition to the sugar and pineapple industries, cattle raising is conducted extensively in central Maui. There are also several large chicken ranches and numerous truck farms producing for the Honolulu trade.

The port of Kahului is the only port on Maui where ships tie up regularly alongside a wharf. At the small ports of Hana and Mala some of the smaller vessels dock at infrequent intervals, but the larger vessels are required to discharge by lighter. The town of Kahului is owned by the Kahului Railroad, which furnishes transportation to and from the port. Wailuku, the largest town on the island, is located about 3 miles from Kahului, and, although it is an independent community to the extent that much of the property is privately owned, it is also the headquarters of one of the sugar companies. Puunene and Paia are headquarters of the two leading sugar plantations, and the towns are owned by the companies. These companies have large areas planted in cane in central Maui and they extend in the direction of the region where plague has occurred, one plague rat having been found, according to the records, at the Paia Mill, about 6 miles from the docks of Kahului. The town of Makawao, which is in the immediate vicinity of most of the rodent plague found to date, is a small independent community surrounded by pineapple land owned by several of the leading pineapple companies and small growers. Headquarters of the companies are at Haliimaile, Haiku, and Pauwela.

There are numerous gulches in the area where plague-infected rats have been found. Some of the gulches carry water during heavy rains but are dry most of the time; others are dry all of the time. Vegetation in the gulches is profuse and consists of a variety of wild plants, including beans, berries, and fruits, together with dense brush, and in many cases there is a heavy growth of cactus. In some instances sides of the gulches have been planted in pineapple, but this

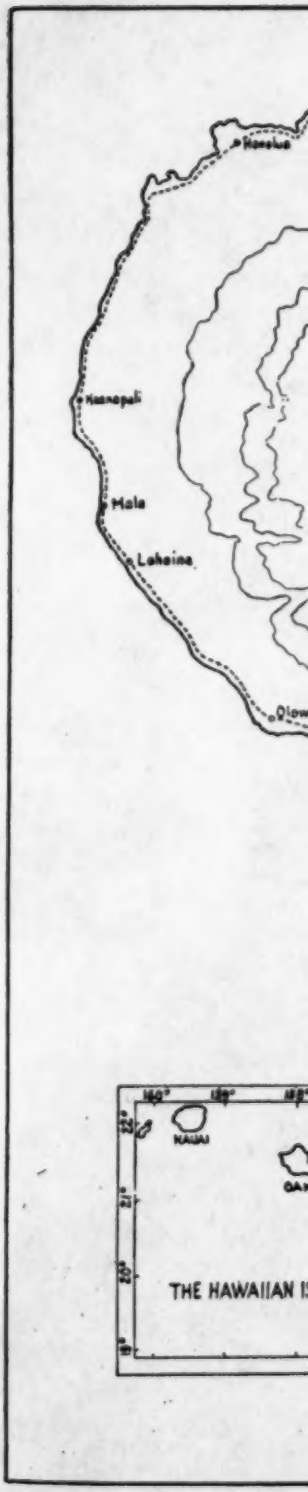
has not been the general practice. There are also numerous large rock piles and rock walls in this area.

There is an excellent system of highways on Maui, and all roads between important towns are hard surfaced. A hard-surfaced road was completed in 1935 to the rim of the crater of Haleakala, facilitating the travel of tourists to this scenic attraction. There are altogether 155 miles of hard-surfaced road on the island, practically all of which is in central Maui, where almost three-fourths of the population is located. Although the Kahului Railroad has train service between various points at the lower elevations, there is a great deal of automobile trucking, especially during the summer months when the canneries are operating full time. There are no pineapple canneries in the Makawao district, and all fruit must be shipped by truck to canneries at Haiku, Pauwela, or Kahului. In spite of this, plague has not been found recently at any of these places. In the Kula region there is considerable dry farming, principally by small vegetable growers, and the produce is transported in trucks twice a week to Kahului for shipment by steamer to Honolulu and elsewhere.

SANITATION AND THE LOCAL HEALTH ORGANIZATION

Company towns such as Paia, Puunene, and Kahului, consist principally of employees' dwellings and company stores. In the case of the laboring classes, which are largely composed of Filipinos and Japanese, the houses are grouped into camps. In addition to living quarters the laborers of plantations are furnished medical service at the company hospitals as part of their compensation. Camp policemen are provided by the companies to look after sanitary and other conditions in the camps; and, since the plantations have been generally prosperous and under good management, the sanitary conditions have generally been good, with a few exceptions.

Local government on the island is in the hands of a county board of supervisors, the county of Maui including the entire island of Maui and other areas. However, in matters of health the county governs only its own hospitals; all other public health work is conducted by the Territorial board of health. On Maui at the time of this report, there are four board of health sanitary inspectors and a number of nurses engaged in full-time routine activities; and in addition to these a number of local doctors conduct work in different sections of the island for the Territorial board of health on a part-time basis. Visiting nurses are also employed by the plantations for work in the camps. Plague work is handled by a separate organization under the general direction of the Territorial health officer in cooperation with the United States Public Health Service, and at the present time is being supported financially by the Territorial




ISLAND OF
MILES
LEGEND
Main
Roden
Town
PACIFIC OCEAN
Kahului Harbor
Paia
Makawao
Crater of Haleakala
Olowalu
Airport
Puunene
Kula Sanatorium
Kanaio
Kaupo
Keanae
HAWAIIAN ISLANDS
OAHU
MOLOKAI
MAUI
LANAI
HAWAII

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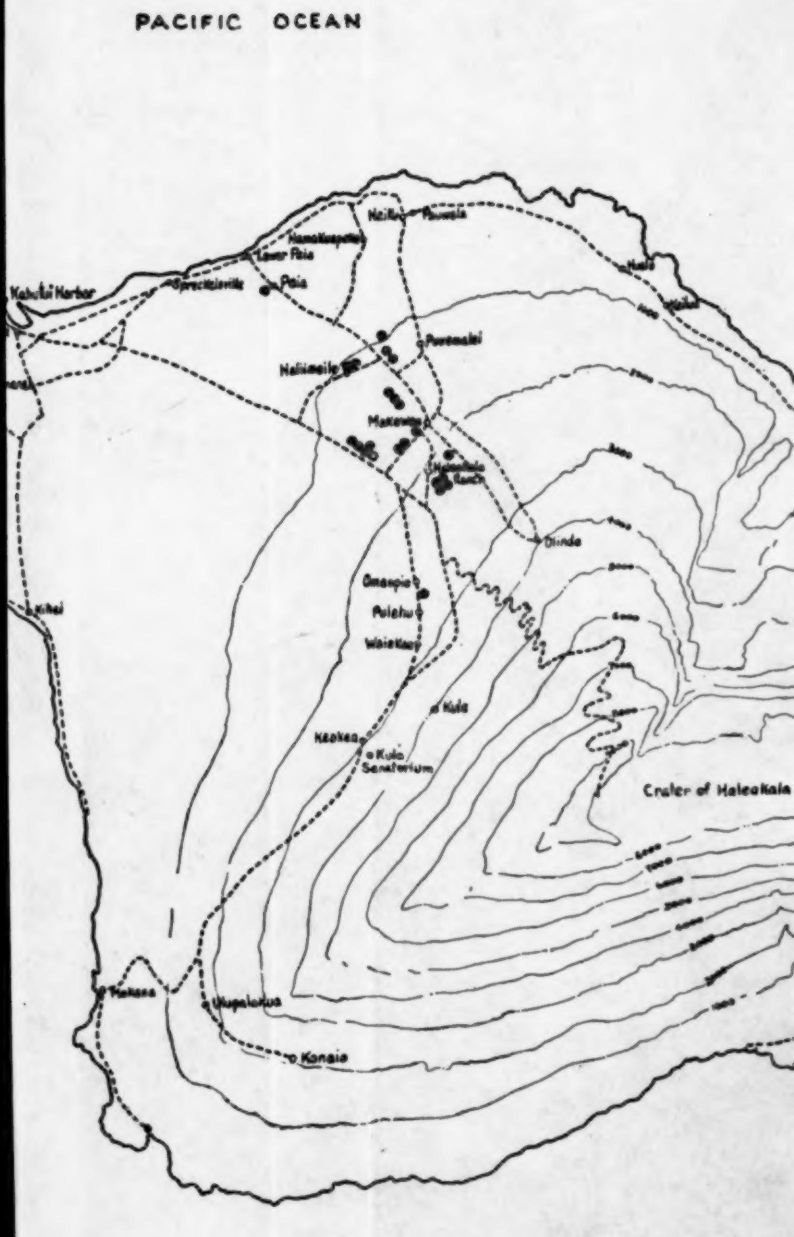
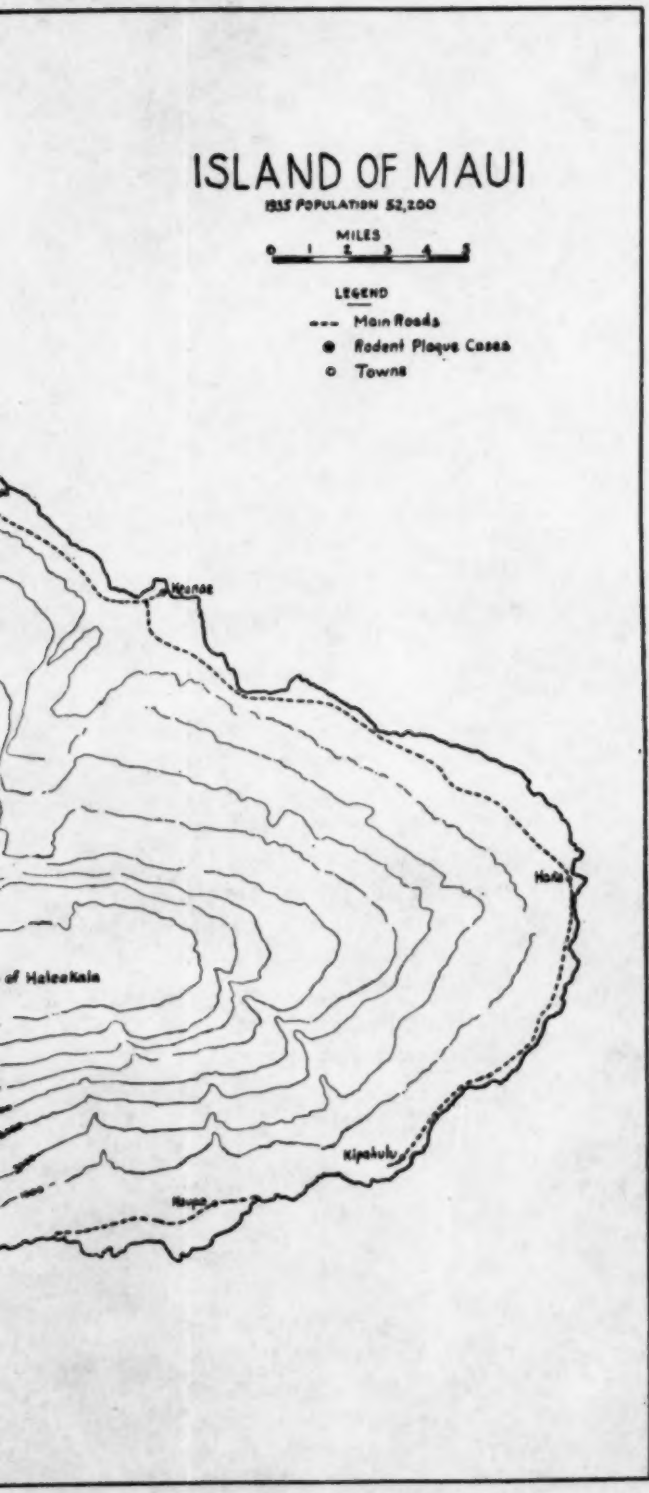
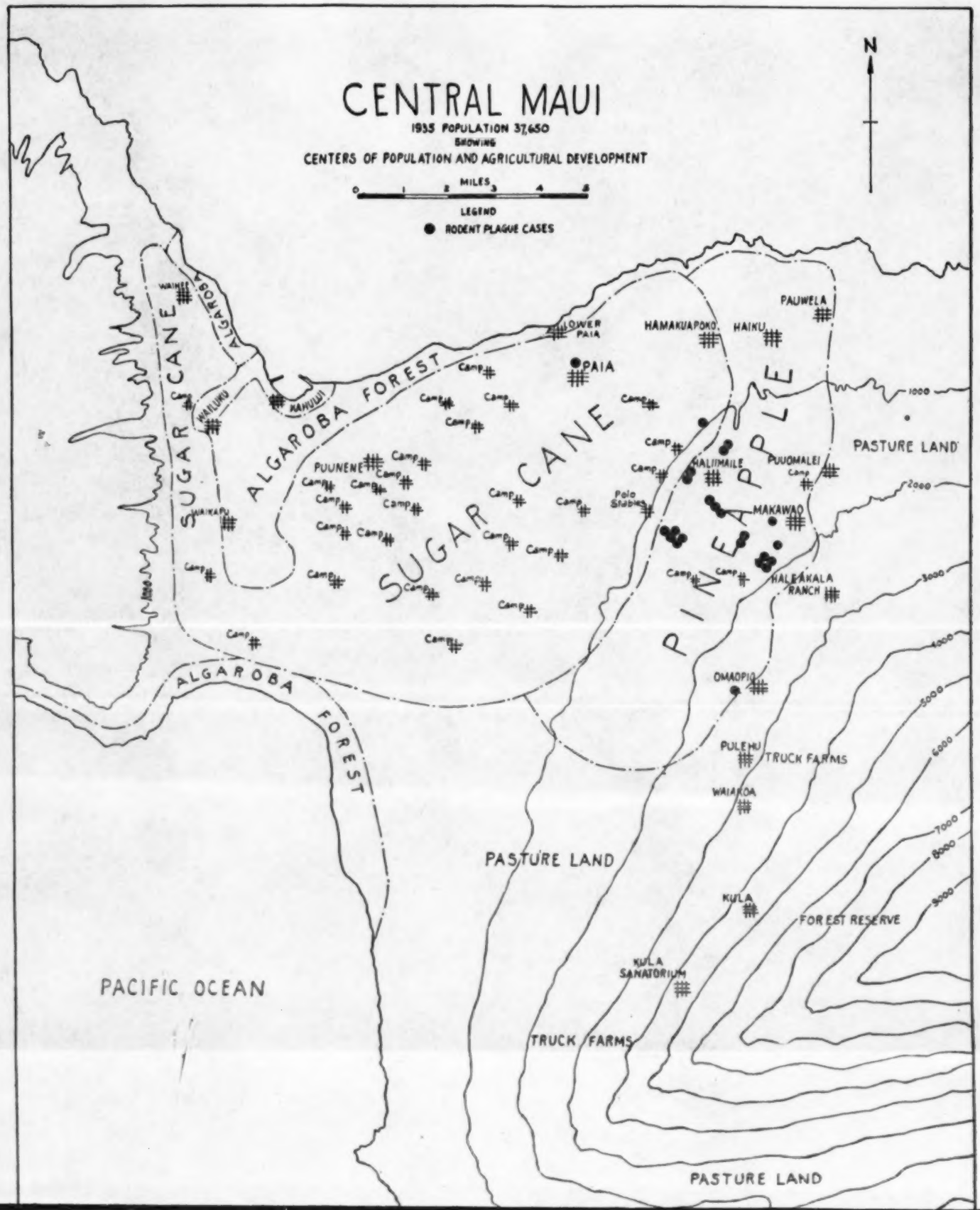
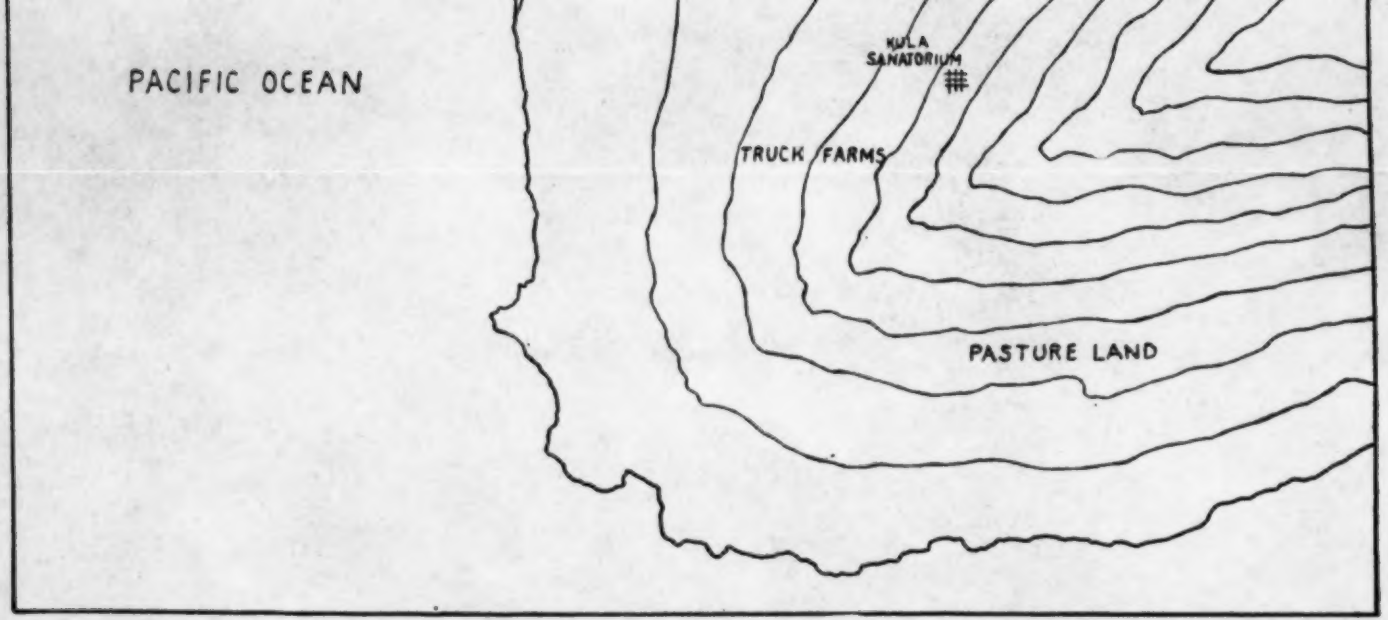
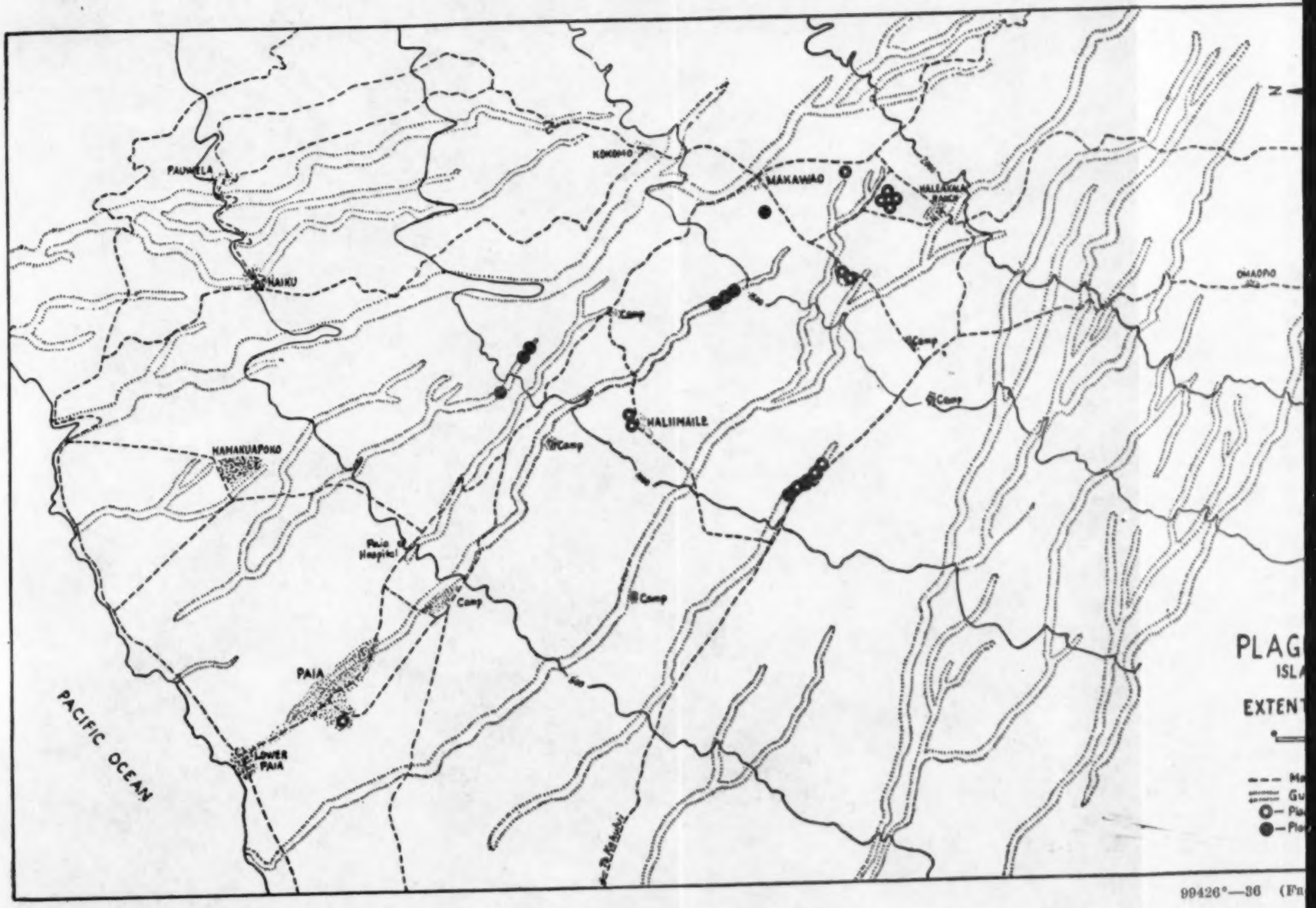

PACIFIC OCEAN
Kahului Harbor
Spreckelsville
Lower Paia
Paia
Haiku
Pauwela
Haliimaile
Makawao
Olinda
Omaopio
Pulehu
Waiakoa
Kula
Keokea
Kula Sanatorium
Crater of Haleakala
Kihei
Makena
Ulupalakua
Kanaio


ISLAND OF MAUI
1935 POPULATION 52,200
MILES
0 1 2 3 4 5
LEGEND
Main Roads
Rodent Plague Cases
Towns
Hana
Hana
of Haleakala
Kipahulu
Kaupo

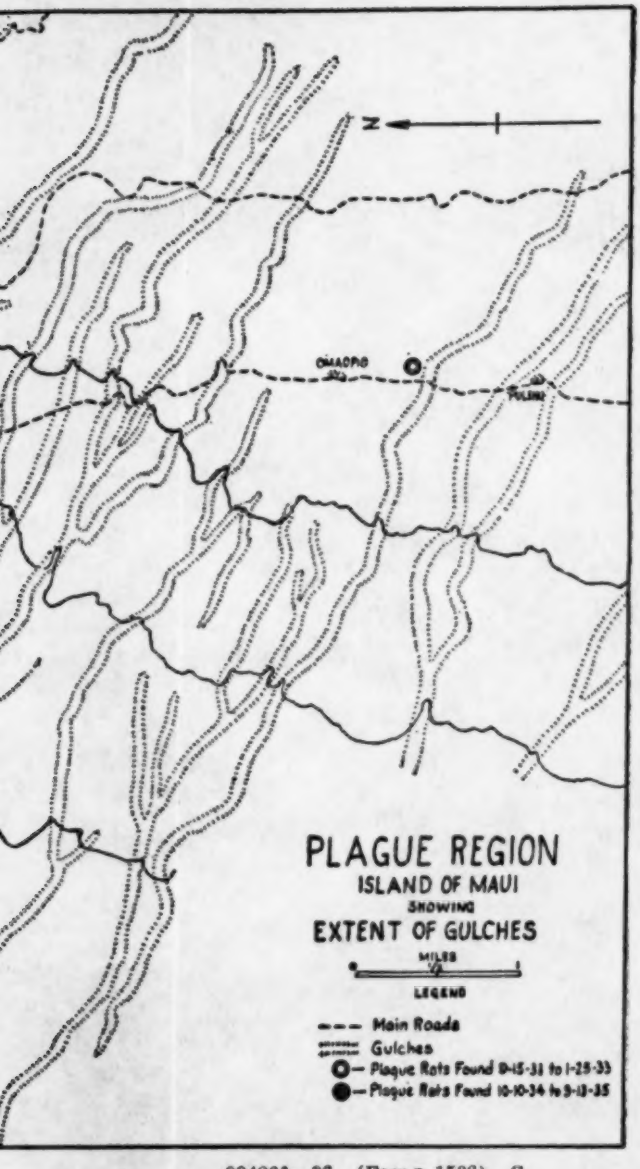

CENTRAL MAUI
1935 POPULATION 37,650
SHOWING
CENTERS OF POPULATION AND AGRICULTURAL DEVELOPMENT
0 1 2 MILES 3 4 5
LEGEND
RODENT PLAGUE CASES
N
SUGAR CANE
ALGAROBA FOREST
WAIHEE
WAILUKU
KAHULUI
PUUNENE
HUAKAPU
PAIA
LOWER PAIA
HAMAKUAPOKO
HAIKU
PAUWELA
HALIIMAILE
PUUOMALEI
Polo Stadium
MAKAWAO
HALEAKALA RANCH
PINEAPPLE
PASTURE LAND
OMAOPIO
PULEHU
TRUCK FARMS
WAIAKOA
KULA
FOREST RESERVE
KULA SANATORIUM
PACIFIC OCEAN
1000
2000
3000
4000
5000
6000
7000
8000
9000
Camp


PUUNENE
Camp
WAIKAPU
SUGAR CANE
ALGAROBA FOREST
HALIIMAILE
PUUOMALEI
Polo Stables
MAKAWAO
PINEAPPLE
HALEAKALA RANCH
2000
3000
4000
5000
6000
7000
8000
9000
OMAOPIO
PULEHU
TRUCK FARMS
WAIAKOA
PASTURE LAND
KULA
FOREST RESERVE
KULA SANATORIUM
PACIFIC OCEAN


PACIFIC OCEAN
KULA SANATORIUM
TRUCK FARMS
PASTURE LAND


PAUWELA
KOKOMO
MAKAWAO
HALEAKALA RANCH
HAIKU
OMAOPIO
Camp
HALIIMAILE
KAMAKUAPOKO
Paia Hospital
PAIA
LOWER PAIA
PACIFIC OCEAN
PLAG
ISLA
EXTENT


KOKOMO
MAKAWAO
Camp
Camp
Camp
HALIIMAILE
Camp
Camp


N
OMAOPO
PUUNIU
PLAGUE REGION
ISLAND OF MAUI
SHOWING
EXTENT OF GULCHES
MILES
LEGEND
Main Roads
Gulches
Plague Rats Found 9-15-31 to 1-25-33
Plague Rats Found 10-10-34 to 3-13-35

board of health, the United States Public Health Service, the Quarantine Tax Fund Commission of the Maui Chamber of Commerce (which collects a tax on incoming freight), the Federal Emergency Relief Administration, the Federal Rat-abatement Project Fund, and various plantation companies located in and around the plague region. The personnel engaged in the plague campaign at the time of this report (April 1936) consisted of the sanitary engineer in charge, 2 sanitary inspectors, 2 laboratory technicians, 1 clerk-stenographer, 1 field foreman, 1 assistant field foreman, 7 subforemen, 20 rat trappers, and approximately 200 field laborers, some of the latter working on a part-time basis. Approximately 50 of the laborers were furnished by plantations for work on plantation property.

OCCURRENCE OF PLAGUE IN THE TERRITORY OF HAWAII

Plague was first reported in the islands on Oahu at Honolulu in the latter part of the year 1899, and shortly thereafter it appeared on the islands of Hawaii, Maui, and Kauai. An epidemic occurred in Honolulu in 1900, and cases were found there for several years thereafter, but the disease apparently died out, as the last reported plague-infected rat in Honolulu was found in 1907. The last plague-infected rat found on the island of Oahu was in 1911.

The disease was apparently also short-lived on the island of Kauai, as no plague infection has been reported there since 1906. It has persisted on the island of Hawaii where, although it disappeared from the port of Hilo, it became entrenched in the Hamakua district about 40 miles from Hilo. Both human and rodent plague cases continue to be found in the Hamakua district of the island of Hawaii.

On the island of Maui, plague is reported to have first appeared at Kahului in the year 1900 and is believed to have been brought to this port by interisland steamer from Honolulu. The town was burned, and no evidence of the disease was again recorded until 1930, in which year it is believed that a number of deaths may have been due to plague. In August 1931 the first human case was definitely diagnosed as such, and between this time and September 1932 there were five cases with four deaths. All of these cases occurred in the vicinity of Makawao. No human plague is known to have occurred on this island since September 1932.

In September 1931 the first plague-infected rat was found at Haliimaile in the Makawao district and between this time and January 25, 1933, the records show that 15 plague-infected rats were found in 7 foci. In one instance infection was determined by mass inoculation. Then there was a lapse of over 20 months before the next infection was located on October 10, 1934, and between this date and September 13, 1935, nine plague-infected rats were found in five foci. This latter group of cases cannot be considered as a separate outbreak

as one of the foci was identical with one in the earlier group. The failure to locate plague during the 20-month interval was probably due to the character of the control activities during that period.

OBSERVATIONS ON THE RAT PROBLEM IN MAUI

The program in force in October 1933, when the writer came to Maui, consisted of the distribution of poison bait over an area of about 170 square miles, covering practically all of central Maui, supplemented by a small amount of trapping and laboratory examination of rats. Approximately 1½ million packages of poison were being distributed per month and the area was being covered once every 2 months. Poison bait consisted of mixtures of rolled barley, rice, or wheat, with corn oil or bacon, plus about 10 percent by weight of powdered arsenic. This mixture was wrapped in pieces of waxed paper 4 inches square, with the ends twisted to form the shape of a torpedo. Five trappers were bringing into the laboratory approximately 40 rats per day. Trapping was being carried out mostly in built-up areas, and there was no foreman. In the laboratory all rats were being examined macroscopically and one mass inoculation was made each day, using material from all rats examined. When a suspicious rat was found by macroscopical examination, inoculation of a separate animal was made and slides were prepared for examination under the microscope.

The only species of rats found in central Maui were *Rattus hawaiiensis*, *Rattus alexandrinus*, and *Rattus rattus*. For some unknown reason *R. norvegicus*, the most common rat in some regions, was not trapped at all, either at sea level or higher elevations, in this section. The records show that it was trapped in other parts of the island both at sea level and at higher elevations. *R. alexandrinus* and *R. rattus* were found mostly in or near buildings and also in nests in algaroba (mesquite) trees. The native rat, *R. hawaiiensis*, typically a field rat, was found mostly in gulches and old pineapple fields and along the edges of cane fields. It is much smaller than the other two species and was found to be less hardy and wary and easier to trap. According to the records, more than one-half of the rats trapped were *R. hawaiiensis*.

The mongoose was brought to this island some years ago to control the rat population on account of rat damage to cane in some sections and is found today in all parts of the island. It is believed, however, not to have had any marked effect on the rat population, probably due to the fact that it is active during the day whereas the rat carries on its activities during the night.

In view of the fact that the area in question was mostly rural and the work was concerned largely with a field rat, the poisoning program

presented the least difficulties. There were no data available, however, to indicate that this program was actually accomplishing the desired result, namely, the reduction of the rat population to a point where plague would die out, or that it had been successful elsewhere. Poisoned rats could not be found and the rat catch was not diminishing, as shown in table 2. According to reports of the rat catchers, rats were being caught mostly in gulches and in old pineapple fields overgrown with brush and weeds, and investigations in the field showed that there was a plentiful supply of natural food in the

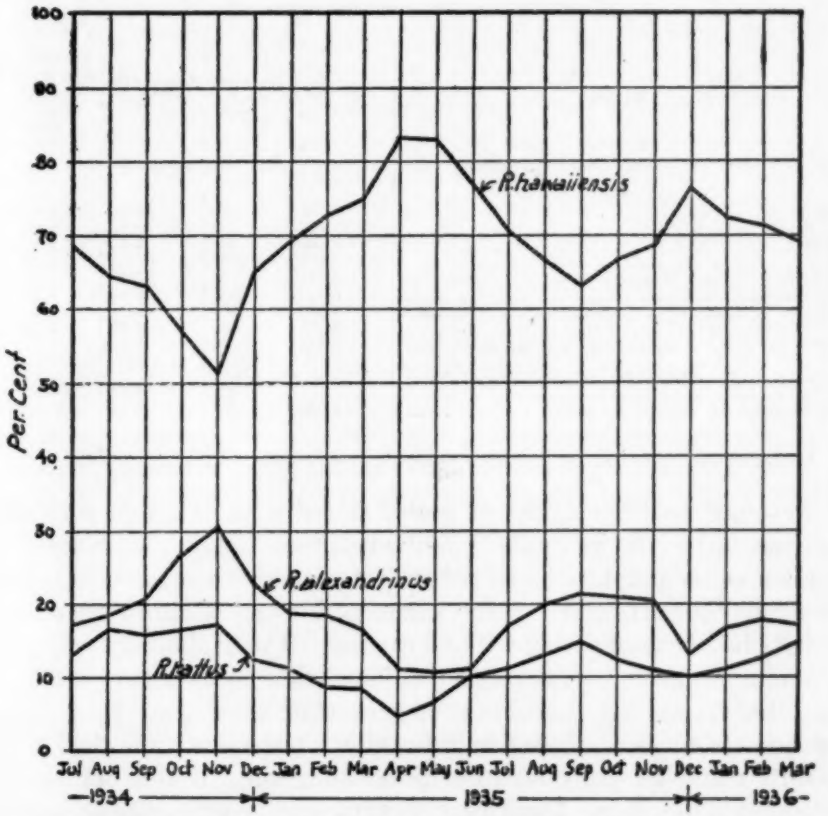


FIGURE 1.—Percentages of various species of rats caught in plague zone and adjacent areas.

gulches and elsewhere in the form of wild berries, seeds, and fruits during the entire year. At least a dozen different varieties of rat-eaten food could be picked up in a short time, including the fruit of the cactus which grows prolifically in certain sections. It appeared, therefore, that there was no great inducement for rats to eat poisoned food to any extent when such an abundance of other food was available.

A study of the locations where plague-infected rats had been found up to that time showed that those that had not actually been taken

out of gulches or old pineapple fields had been found in places adjacent to heavily rat-infested fields or gulches. It was also noted that 12 of the 15 plague-infected rats were of the species *alexandrinus* or *rattus*, and it appeared probable that rats of these species were preying upon the smaller and more numerous *hawaiiensis*. It seemed likely that the reservoir of infection was in the *hawaiiensis* and that it was being brought to the surface by the other two species.

TABLE 2.—*Results of trapping in Makawao (plague zone) during intensive poisoning campaign*

[From files of the Territorial board of health]

Month	Rat trap days	Number of rats caught	Rats per 100 traps per day	Packages of poison placed in central Maui (including Makawao)
1933				
April	3,705	490	13.22	1,001,726
May	3,900	404	10.35	1,265,283
June	3,894	301	7.73	1,335,523
July	3,629	134	[1] 3.69	1,055,401
August	3,693	265	7.17	1,565,196
September	3,735	352	9.42	1,240,000
October	3,888	379	9.74	1,310,175
November	3,590	404	11.25	1,561,655
December	3,742	302	8.07	753,105
1934				
January	3,617	429	11.86	770,770
February	3,268	332	10.15	826,359

[1] Low figure due to poor trapping by trapper who worked 7 weeks only.

Poisoned bait consisting of grains mixed with thallium sulphate, barium carbonate, and other poisons had been used for some time by certain sugar plantations to reduce rat damage to sugar cane. One company in particular, on the island of Hawaii, claimed that good results had been obtained with wheat treated with thallium sulphate. Upon investigation, however, it was found that no data were available and that results were based only on general observations. It appeared reasonable to assume that in a heavily rat-infested cane field some results could be expected from poisoned grain. It did not appear reasonable to assume, however, that rats would continue to eat poison or eat it to such an extent that the rat population would decrease to the point where plague would die out.

In the area in question on Maui, managers of sugar plantations stated that rat damage to cane was negligible. Trappers' records showed that very few rats were being caught in cane fields, although traps could be set only along the edges of the fields and along watercourses, as the fields in most cases were so dense that it was impossible for the trapper to penetrate them very far without losing his way. Due to the plowing of the cane land into ridges and furrows and the

irrigation of this land about twice a month by flooding, it appeared quite natural that there would be but a small rat population.

Rat damage to pineapple fields was limited to the later crops, or ratoons, and the amount of damage was stated to be about proportionate to the age of the field. The rat population in the pineapple fields also appeared to be in proportion to the age of the field according to the trappers' reports. It is not customary to weed pineapple fields, and after about the fourth year there is a fairly dense growth of weeds and other vegetation extending above the plants, occasionally growing to two or three times the height of the plants. Since the plant crop is not harvested until the second year and there are often four ratoon crops, pineapple fields are sometimes 6 years old before they are abandoned and plowed under. Owing to a poor market during the early depression years, many fields were abandoned and not plowed under for replanting, and as a result there was a great deal of heavily rat-infested land in the pineapple region.

Cane, on the other hand, is harvested in from 15 to 18 months after planting, and the land is immediately cleared for replanting or for a ratoon crop. When a crop is ready to harvest, the fields are set on fire and the flames burn up the dry leaves and trash without injuring the cane stalk, and in the burning process many of the rats that are in the field are killed either by the heat or by the workers.

These differences between the growing of cane and pineapple may account for the fact that plague existed in the pineapple region rather than in the cane region, although climatic conditions and the extent of gulches and other waste land in the Makawao district affording excellent rat harborage and food may also have been a factor.

In the section along the seacoast from Kahului to Lower Paia it was found that rats of the species *alexandrinus* and *rattus* were nesting in large numbers in the algaroba trees. These trees produce a bean during most of the year, which is eaten by the rat. The nests resembled bird nests but were usually larger and not as carefully made, and they could easily be distinguished after comparing a few of them. Nests were found with as many as 13 rats each. They could be brought down readily with a shotgun, but many sections were practically inaccessible at the time on account of the dense brush on the ground.

Buildings in and around the plague zone were generally poor from a ratproof standpoint. There were numerous small structures, such as pigpens, privies, wash houses, chicken coops, and various types of out-houses, which afforded potential if not actual rat harborage and which had never been inspected from a plague-control standpoint.

The piers and pier sheds at Kahului were of modern concrete construction and were free from rat harbors, with the exception of certain open spaces under the floors which were accessible to rats.

STUDY OF THE MEASURES IN USE

In view of the lack of information at the time concerning the effectiveness of the poisoning program, it was decided to carry on some experiments both in cages and in the field in order to obtain such data.

TABLE 3.—*Results of cage experiments using arsenic*

Experiment no.	Number and species of rats used				Number of rats dying	Days poison was eaten	Period of experiment (days)
	R. alexandrinus	*R. rattus*	*R. hawaiiensis*	Total			
1	4	1	0	5	3	First	5
2	0	5	0	5	2	First and second	5
3	0	0	4	4	1	First	5
4	6	2	0	8	4	do	5
5	5	2	0	7	1	First and second	10
6	0	7	0	7	0	First	10
7	4	1	0	5	1	do	5½
8	4	2	0	6	1	do	4
9	8	4	0	12	4	First, second, and third.	7½
10	4	4	0	8	2	do	17½
11	7	10	0	17	1	First and second	10
12	5	1	0	6	1	First	21
13	0	0	10	10	2	do	12
14	6	10	0	16	5	First, second, and third.	9
15	7	3	0	10	2	First and second	7
16	0	0	10	10	5	do	7
17	8	12	0	20	1	do	7
18	0	0	10	10	4	First	7
19	0	0	10	10	6	do	7

NOTE—Poison consisted of mixtures of rolled barley, rice, or wheat with corn oil plus 10 percent by weight of powdered arsenic and wrapped in waxed paper. Poison package was replaced with fresh package each morning and oftener when necessary.

Two cages, each 10 feet long by 18 inches wide by 18 inches high, were constructed of wood and lined with ½-inch mesh wire screen. Screen partitions were built in so as to make five compartments, and small openings cut in at the bottom of each partition to provide passage from one compartment to another. The top of each compartment was on hinges to gain entrance. The principal object in building the cage in this way was to keep the food and poison in one place so that a record could conveniently be kept of the amount taken at various times. It was also desired to provide enough floor area and climbing space to accomodate 10 rats without crowding and to avoid fighting. It was realized that the information to be obtained from any cage experiments would be limited, and it was desired to determine mainly to what extent rats would eat poison under these conditions. Natural food found in the gulches and elsewhere was placed in one end compartment together with poisoned bait and water, and burlap bags were placed in the other end as nesting material.

In order to carry on experiments with larger numbers of rats than these cages would accommodate, a larger cage was built later by screening a portion of the storeroom in the laboratory building with one-

half inch mesh wire screen, making a cage 12 feet long by 6 feet wide by 6 feet high.

Experiments were first conducted with mixtures containing arsenic, using packages from the supply on hand, and then similar work was done with wheat treated with thallium sulphate, using 4 pounds of thallium sulphate per 1,000 pounds of grain. The results obtained with arsenic are shown in table 3 and those with thallium sulphate in table 4. There was a variation in the number of rats used per experiment and in the sources from which the rats were obtained. It was found that some rats were occasionally killed in fighting when caged, but no large number of control experiments were conducted to determine the probable loss on this account and no allowance for this factor has been made. It was frequently necessary to collect rats over a period of several weeks to obtain a sufficient number from a certain locality to begin the experiment; and it was found that if a group of rats were kept in a cage for several weeks or more, additional rats placed in the cage would be killed by the others in a short time. Consequently, the rats used in a particular experiment could not be collected over a long period of time unless they were kept in separate cages before placing them in the experiment cage.

TABLE 4.—*Results of cage experiments using thallium sulphate*

Experiment no.	Number and species of rats used				Number of rats dying	Days poison was eaten	Period of experiment (days)
	R. alexandrinus	*R. rattus*	*R. hawaiiensis*	Total			
1	6	2	0	8	3	First, second, and third.	7½
2	3	5	0	8	1	First	7
3	1	7	0	8	6	First, second, and third.	7
4	8	2	0	10	1	First and second	7
5	0	0	10	10	7	First	7
6	8	2	0	10	3	First and second	7
7	12	16	0	28	5	First, second, and fourth.	12
8 [1]	13	10	0	23	2	Third and fourth	8
9 [2]	12	9	0	21	0	None	6
10	6	6	0	12	6	First and second	7
11	0	0	10	10	8	First, second, and third.	12

[1] Rats remaining from experiment no. 7 used after interval of 1 week.
[2] Rats remaining from experiment no. 8 used after interval of 1 week.

NOTE.—Poison consisted of wheat mixed with thallium sulphate, wrapped in waxed paper (4 pounds of thallium sulphate per 1,000 pounds of grain). Poison package was replaced with fresh package each morning and oftener when necessary.

The species of rats used for each experiment consisted of either a mixture of *alexandrinus* and *rattus*, or of *hawaiiensis* alone. *Alexandrinus* and *rattus* were mixed in the cages because they had frequently been found together in nests in trees and it facilitated carrying out the experiments, owing to the difficulty of trapping a sufficient number of one species in a short time. Trapping live rats was found to be difficult in some sections because the mongoose frequently killed the rat

in the cage, if the trapper did not empty his traps at daybreak, and the small *hawaiiensis* frequently escaped by forcing its way out between the wires where the mushroom type of cage trap was used.

The considerable variation in the results obtained may be due to various factors, especially the fact that, on account of the difficulty of trapping live rats, groups of rats were occasionally used which were obtained from different locations and which had been feeding on different kinds of foods. Both wet and dry foods were used in each experiment, and an attempt was made to obtain the kinds of foods on which the rats had been feeding, although this was not always practicable where a group of rats used in an experiment had been obtained from a number of locations. The cage experiments do not give an accurate picture of what might take place in the field, owing to the fact that the poisoned grain was at all times available, together with the other food, in a small area, and also owing to the fact that the rats were caged. They do demonstrate, however, that after one or more rats have eaten the poison and have become sick or have died from the effects the remaining rats almost invariably refuse to touch the package, and consequently the poison is not eaten after the first day or two.

Thallium sulphate appeared to be slightly more effective than arsenic, probably on account of its slower action, as a result of which it was taken over a longer period of time before it was recognized. Obviously, the effect of thallium sulphate was more pronounced on the *hawaiiensis* than on the other two species on account of the smaller size of this rat.

The ability of rats to recognize the poison even after a considerable period of time was clearly demonstrated in experiments 7, 8, and 9 shown in table 4. In experiment 7, 5 of the 28 rats died from the effects of the poison in the first few days of the 12-day experiment. The remaining 23 rats were then fed without poison in the same cage for 1 week, at the end of which time the poison was again introduced. Experiment 8 shows that only 2 of the 23 rats died during the 8 days in which poison was in the cage in this second period. Poison was then again removed from the cage for 1 week, after which time it was reintroduced for a third period, and during the 6 days' duration of this period, shown in experiment 9, none of the remaining 21 rats even opened the package.

At various times between March and June 1934, poison experiments were carried out in the field, using special areas set aside for this purpose. These areas varied in size from 500 to 1,500 acres, were located in different parts of the region being worked, and also varied as to kind of vegetation. The procedure was to trap an area for a week, then place poison packages and trap for another week with the object of determining whether there resulted any marked reduction in the

rate of rat catch which might be attributable to the poisoning. In all experiments the number of packages distributed in a certain locality depended on the nature of the area. In built-up areas, packages were placed in buildings wherever there appeared to be a likelihood of encountering rats. In areas planted in cane where the cane was too dense for the worker to go into the field, three packages were placed on the ground about every 25 feet along the edges of the field and along water courses. In pineapple fields two packages were placed every 10 feet along every other row. This procedure of placing in cane and pineapple fields was the same as that used in the original poisoning campaign. Arsenic was used in the first group of experiments, the results of which are shown in table 5. Coconut was used as trap bait in this as well as in all other work.

TABLE 5.—*Results of field experiments with poison using arsenic mixed with wheat, rice, or barley*

MARCH-JUNE 1934

Experiment no.	Area in acres (approximate)	Interval since previous poisoning	Trapping results during week before placing poison		Packages of poison placed	Interval between first and second trapping (weeks)	Trapping results during week after placing poison	
			Rats caught	Rats per 100 traps per day			Rats caught	Rats per 100 traps per day
1	1,500	6 weeks	86	6.14	30,479	1	82	5.86
2	1,000	2 months	180	12.86	24,144	1	179	12.79
3	500	10 weeks	58	4.14	10,647	1	53	3.79
4	500	2 months	106	7.59	7,096	2	142	10.14
5	500	10 weeks	99	7.08	6,727	0	51	3.64
6	500	6 weeks	87	6.21	50,619	1	114	8.16
7	500	5 months	57	4.14	11,993	4	78	5.59
8	500	do	70	5.02	3,591	3	89	6.41
9	500	2 weeks	[1] 123 125	8.79 9.67	7,834	0	111	7.93
10	500	do	[1] 95 59	6.79 4.21	26,910	0	72	5.14

[1] Area was trapped for 2 weeks before placing poison and 1 week after. Upper figure represents rats caught first week, lower figure rats caught second week.

NOTE.—In cane land three packages were placed every 25 feet along the outer edges and along water courses. In pineapple land two packages were placed every 10 feet along every other row. This method of placing determined the total number of packages per experiment.

It will be noted that the rates of rat catch vary considerably. Results such as these are to be expected in areas with numerous rat harborages and natural food in abundance, as the rat is not necessarily attracted to the trap out of hunger. In such areas the results probably depend more upon the luck than upon the skill of the trapper. It will be noted that in several instances the rate of rat catch after placing poison was higher than before, and only in one instance, experiment 5, was there a marked drop. In order to determine whether the results in experiment 5 were temporary as a result of trapping, owing to the fact that there was no interval between first and second trapping, or whether they were possibly accidental, experiments 9 and 10 were carried out on the same basis but with trapping

conducted for 2 weeks before poisoning. It will be noted that in the second week of trapping in experiment 10 there was a drop in catch without poisoning almost equal to that shown in experiment 5. It is also possible that the rat population in the area used in experiment 5 was not large and was actually reduced by trapping. Land in this area was planted in hay and corn, whereas all other districts contained cane or pineapple.

The results of these field tests with arsenic indicate that the poison was having no noticeable effect on the rat population.

Beginning July 1, 1934, the trapping districts were increased in number and rearranged so that trapping was intensified in the plague zone and surrounding areas. The placing of poison was continued in the trapping districts, with the exception of one small district which was used as a control, and at the same time the poisoning of areas outside the districts was discontinued. Table 6 shows that there was no apparent effect on the rat catch from arsenic poisoning in the districts in the plague zone during the calendar year 1934. The increase in trap days also did not affect the rate, although this was not anticipated unless it were to be done on a much larger scale, and even then permanent results could not be expected. In the small control district there was a gradual reduction in the rate of catch from 16.87 rats per 100 traps per day in July, to 8.60 in December, due to trapping alone, as shown in the first part of figure 2, but it was believed that this rate could not be reduced much further without a direct attack on the rat burrow and on the natural food supply.

TABLE 6.—*Rate of rat catch in and adjacent to the plague zone during 12 months in which poison was placed*

Month	Rat-trap days	Number of rats caught	Rats per 100 traps per day	Packages of poison placed
1934				
January	9,685	728	7.52	294,876
February	9,010	689	7.64	348,639
March	8,650	524	6.06	248,509
April	7,060	474	6.71	231,056
May	9,881	847	8.57	103,669
June	23,482	1,695	7.22	178,122
July	34,473	2,437	7.07	354,098
August	43,114	3,086	7.16	108,453
September	38,514	3,145	8.17	101,278
October	41,634	3,444	8.27	122,187
November	40,405	2,750	6.81	134,013
December	43,211	3,429	7.94	101,638

NOTE.—Poison consisted of mixtures of rolled barley, rice, or wheat mixed with corn oil, plus 10 percent by weight of powdered arsenic, and wrapped in waxed paper.

During the period January 1 to May 31, 1935, experiments were carried out with wheat treated with thallium sulphate in two trapping districts, the results of which are shown in table 7. The same control district was used as that used in the previous experiment, but in this case a certain amount of rat harborage elimination and food elimination work, the procedure of which is explained later, was carried out in

this district in conjunction with the trapping. The thallium sulphate treated wheat failed to bring down the rat catch, as shown in table 7. However, there was a continued gradual and marked drop in the catch in the control district from month to month as a result of the combined effects of trapping and rat harborage elimination work. The results of this work in the control district are shown in figure 2.

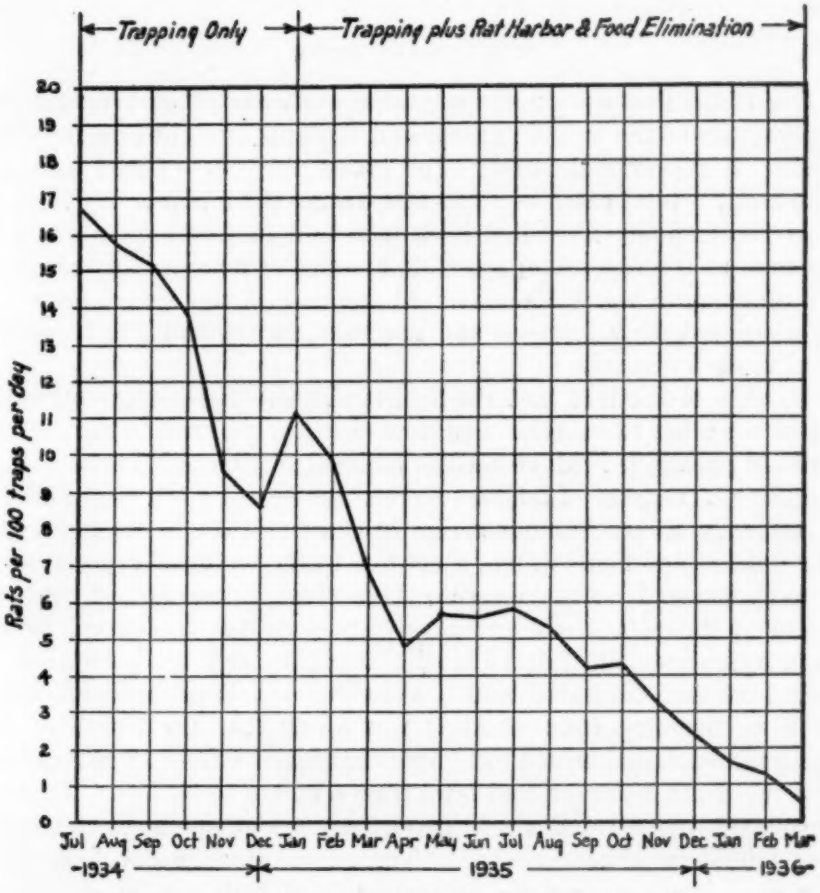


FIGURE 2.—Rate of rat catch in poison-control district (200 traps set daily).

TABLE 7.—*Rate of rat catch in the towns of Wailuku and Haiku, before, during, and after placing poison*

Month	Rat-trap days	Number of rats caught	Rats per 100 traps per day	Packages of poison placed
1934				
December	12,156	871	7.16	0
1935				
January	11,813	832	7.04	46,842
February	10,765	981	9.11	40,814
March	12,325	835	6.78	30,000
April	11,749	1,100	9.36	30,100
May	12,279	995	8.10	0

NOTE.—Poison consisted of thallium sulphate treated wheat (4 pounds of thallium sulphate per 1,000 pounds of grain).

The conclusion was drawn from the experiments just described that, as a major eradicative measure, poison of the character in use could not be expected to be of any particular value in a campaign of this kind. It was believed that it might be of some value as an adjunct to a program of eliminating rat harborage and food elimination and trapping if applied at a time when the rat's normal living conditions and normal supply of food had been disturbed.

PRELIMINARY WORK

One of the first steps made when the work was taken over was the building up of the trapping force and the appointment of a foreman trapper to supervise the work. In October 1933 there were 5 trappers who made a total catch of 1,080 rats during the month. By August 1934 the trapping force had been increased to 15 trappers and one foreman at the expense of a certain amount of poison, and the catch for that month was 6,168 rats. At the time of this report there are 20 districts with a foreman and one subforeman, and 200 traps are used in each district.

In view of the fact that the field rat *R. hawaiiensis* far outnumbered the other two species, and since the supply of rats in the gulches and old pineapple fields seemed to be inexhaustible, with reference to trapping, a number of laborers were obtained from the local Federal Emergency Relief Administration in October 1934 to clear some of the gulches and fields which, according to the trappers' reports, were heavily infested. After clearing these areas, numerous rat burrows could be detected in the ground which could not be located before clearing on account of dense brush. As many as 2,300 burrows were found per acre of cleared land. A number of excavations were made of these burrows, from which it was found that the length of the main tunnel varied from 5 to 18 feet, the diameter from 1½ to 2 inches, and the depth below ground level from 6 inches to 3½ feet. Tunnels encountered had from one to seven burrows or openings and often had laterals at different levels. There were from one to four nests per tunnel system, usually located at dead ends and at elevations above the main tunnel.

As many as 13 rats were found in one tunnel system, and all 3 species were found, the native *hawaiiensis* far outnumbering the other 2 species. In a few cases all three species were found in the same tunnel, but in these cases the rats may have sought temporary shelter after natural living conditions had been disturbed. On the other hand, there is the possibility, as previously stated, that the *alexandrinus* and *rattus* were preying upon the smaller *hawaiiensis*.

Attempts were first made to force the rats out of the burrows and bring them to the laboratory for examination, but the only successful method found of accomplishing this was by filling the tunnel rapidly

with water. Other substances tried were carbon bisulphide, ammonia gas, illuminating gas, a disinfecting gas called Firekill, smoke from bellows, and firecrackers. In cases where only *hawaiiensis* were encountered, a large percentage of the rats died in the burrow from the effects of any of the substances just mentioned. This was not true, however, of *alexandrinus* and *rattus*, as rats of these two species almost invariably escaped from an opening other than the one being treated.

The use of water to drive the rats out was impracticable on a large scale as it frequently required 25 gallons of water to fill one tunnel. Furthermore, on account of the porosity of the soil it was necessary to have a high rate of discharge from the container, which was accomplished in the experiments by emptying a number of pails rapidly. A tank on a truck with one-inch hose was tried, but the rate of flow was not high enough.

Carbon bisulphide was then tried by applying a few drops to each burrow within a radius of about 5 feet and igniting it by throwing a lighted match on one burrow. When the proper amount of carbon bisulpide was applied, there resulted an explosion and flame throughout the tunnel system which killed all species of rats, and those burrows that were connected could be located by the emanation of yellowish fumes.

Later, a calcium cyanide dust pump was obtained and tried out. It was found that, on account of the porous condition of the soil, much of the dust was apparently absorbed in the surrounding ground and did not reach all parts of the tunnel. Also, where the earth was extremely dry, the gas was apparently not developed fast enough to penetrate all parts of the tunnel. In one case where one burrow leading into a tunnel system was being treated with this dust a rat escaped from another opening. In another case a rat ran into a dead end branch and was alive and unaffected when recovered by excavation.

Solidified carbon dioxide, commonly known as dry ice, was also tried out later, but failed to kill any rats, probably owing to the fact that it did not turn into gas rapidly enough to produce a sufficiently high concentration throughout the tunnel, and on account of the porous condition of the soil a great deal of the gas was absorbed in the surrounding ground. Rats were recovered alive and unaffected in practically all experiments with this material.

MEASURES ADOPTED

It was obvious that, if permanent results were to be expected, it would be necessary actually to eliminate rat harborages in the plague zone, both those in the ground and above, and it appeared from the

history of the disease that it would be necessary to make the infected zone and surrounding area practically rat-free before it could be considered plague-free.

In October 1934, three plague-infected rats had been found in a gulch which, after clearing, was found to be porous with rat burrows. The trapper could continue to catch the same number of rats day after day in this gulch without moving the traps, and there was abundant evidence of rat-eaten wild fruit and seeds. Work of clearing this gulch and later of firing burrows in the poison-control district, using carbon bisulphide, seemed to have a marked effect on the trappers' catches in those sections. However, from a survey in the field it appeared that it would be much too great a task to attempt to clear all of the gulches and other waste land systematically, even if activities were confined to the region where plague-infected rats had been found up to that time. Consequently, it was decided to use the daily reports of the trappers and work on those areas where large numbers of rats were being caught regularly. In this way the trapper was obliged to shift his traps when an area was to be cleared, until eventually the rat harborages in his district would be eliminated. Thus the trapper would automatically furnish information concerning the areas to be worked and no time would be wasted by clearing areas not infested. The Federal Emergency Relief Administration was appealed to for additional men and the work was begun on a fairly intensive scale in March 1935. At that time the treatment of rat burrows was still in the experimental stage; intensive work of this nature was not carried out generally until May.

The clearing of rat-infested areas consisted simply of cutting out the brush and piling it in rows or piles to dry, and later burning it. In the case of pineapple fields, the fields were first burned to expose the burrows and the stumps were later either pulled up and allowed to decay or were plowed into the soil. In the treatment of burrows, the procedure of applying carbon bisulphide and then igniting it proved so successful and inexpensive that efforts were concentrated on this method. Carbon bisulphide could be purchased for $1.10 per gallon delivered on Maui in 50-gallon drums, and at a slightly higher price in smaller containers; and after a little practice, using a pint oil can with long spout for applying it, 1 gallon was found to be sufficient for treating about 800 burrows. The men became rapidly efficient in this work and found that better results could be obtained by using a few drops in a burrow than by using larger quantities. No attempt was made to recover rats from burrows, and in each case the openings were plugged with earth and well tamped. From numerous excavations made after treating the burrows with carbon bisulphide and firing, only dead rats were recovered.

GULCH IN PLAGUE ZONE BEFORE CLEARING.

CLEARED GULCH, SHOWING BRUSH PILED IN ROWS ALONG SLOPES FOR BURNING. BURNED MATERIAL IS RAKED TO THE BOTTOM OF THE GULCH.

APPLYING CARBON BISULPHIDE TO RAT BURROWS.

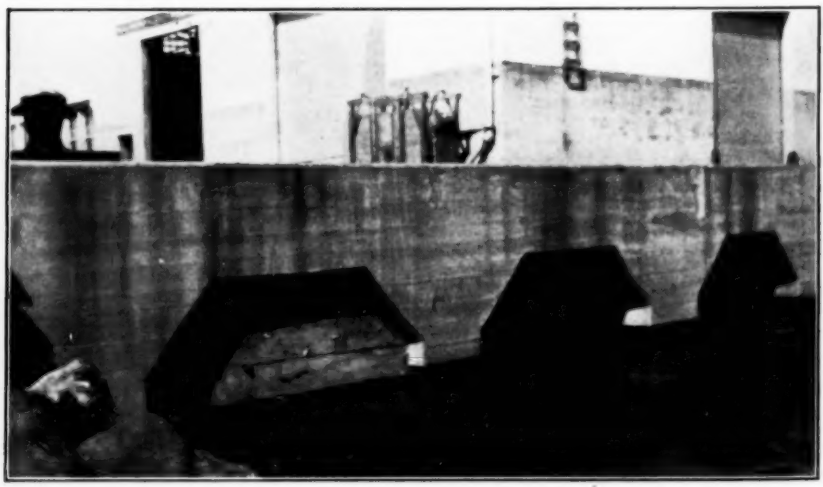
EXCAVATED TUNNEL SYSTEM. THERE WERE 6 OUTLETS TO THIS SYSTEM.

RAT NEST IN ALGAROBA TREE.

OLD PINEAPPLE FIELD OVERGROWN WITH WEEDS.

WORKERS CLEARING DENSE GROWTH OF CACTUS.

CONCRETE RATPROOF PIGPEN APARTMENTS BEING BUILT BY PLANTATION. THESE ARE RENTED TO EMPLOYEES AT A NOMINAL CHARGE PER STALL PER MONTH. NOTE OLD MAKESHIFT PENS IN THE BACKGROUND.



ARCH FILLED IN WITH CONCRETE AT SHORE END OF PIER TO PREVENT RATS FROM GETTING UNDER PIER AND SHED FLOOR.

Immediately after the land had been cleared, a practice was made of distributing, in moderate amounts, packages of wheat treated with thallium sulphate, assuming that at such a time, when the rat's food supply had been cut down and the harborages had been exposed, there would be some likelihood of poisoning a certain number of rats. At such times the rats could often be seen running through the cut brush during the day and some were found dead which, upon examination in the laboratory, appeared to have been poisoned. Every effort was made, while the men were clearing, to kill as many rats as possible and all means possible were employed, including the use of clubs. All workers were instructed to look for dead rats, and in some sections one man was assigned to the job of walking around the area as it was being cleared and looking for dead rats. These procedures resulted in picking up five plague-infected rats in the plague zone from two foci. In one of these cases, the first plague-infected rat was picked up within 2 hours after clearing had begun in a certain gulch and two others were found before the work in the gulch was completed, which required about 6 weeks. In another case, the first plague-infected rat was found on the third day of the work and the second on the fourth day, and both rats were taken from the same focus where, according to the records, three plague rats had been found 3 years previously.

Owing to the fact that it was impracticable to attempt to recover rats from the burrows, any plague-infected rats in the burrows were obviously not located. It appears probable that a fairly large number of plague rats were killed in burrows. It is significant to note that of the six plague-infected rats found as a result of work in the gulches and fields, five were of the species *hawaiiensis*, whereas practically all of the earlier plague was found in the other two species.

TABLE 8.—*Rate of rat catch in the plague zone during 13 months in which rat harborage and food elimination work was carried out*

Month	Rat harborage and food elimination	Rat-trap days	Number of rats caught	Rats per 100 traps per day
1935	*Man-hours*			
March	8,593	36,528	3,071	8.41
April	5,244	36,875	2,495	6.76
May	10,866	37,094	2,664	7.18
June	7,616	35,909	2,280	6.34
July	8,622	37,020	2,375	6.41
August	13,048	37,102	1,742	4.69
September	16,381	34,666	1,061	3.06
October	20,295	36,883	1,059	2.87
November	11,197	35,921	971	2.71
December	15,097	37,170	752	2.02
1936				
January	8,986	37,166	637	1.72
February	10,155	34,740	361	1.04
March	6,981	37,070	248	0.67

NOTE.—During the above period 180,000 burrows were treated with carbon bisulphide and sealed and an average of 10,000 packages of poison per month were placed in conjunction with the rat harborage elimination work.

Results of the rat harborage elimination work, judged by the rate of rat catch from month to month, are shown in table 8. Figures are given for the six plague zone districts, where enough work of this nature has been done to show what is being accomplished. It will be noted that in a period of 13 months ending March 31, 1936, the average rate of rat catch for these districts as a whole was gradually reduced from 8.41 rats per 100 traps per day to 0.67 rats per 100 traps per day. The figure is now so low that it is proposed to reduce the

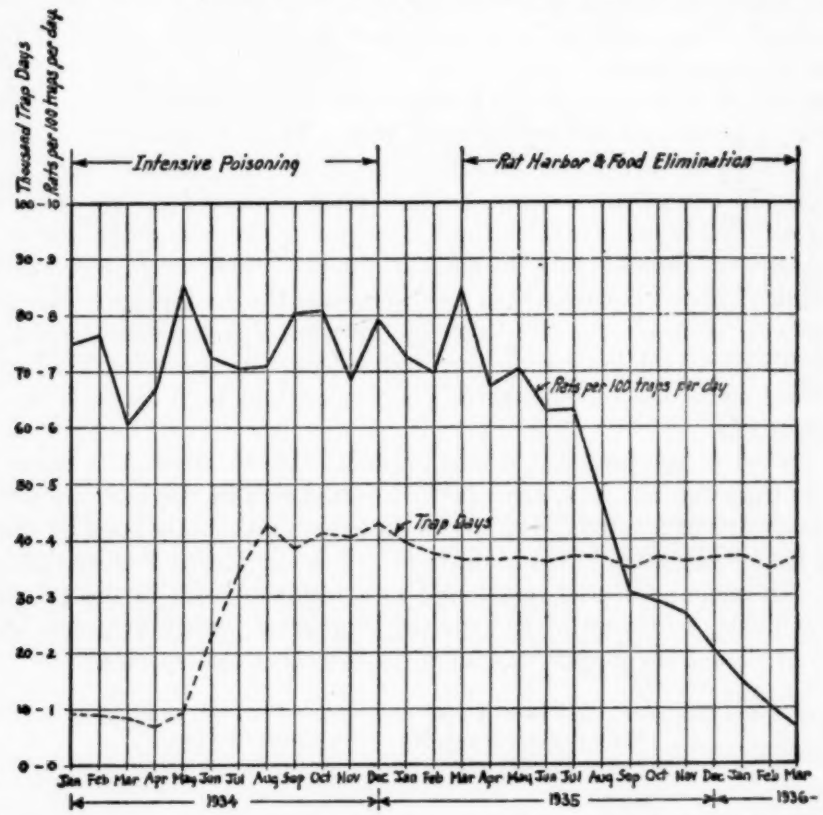


FIGURE 3.—Effect of elimination of food and harborage as compared with poisoning—plague zone and adjacent areas

number of traps in the plague zone by consolidating some of the districts and to attempt to widen this practically rat-free zone by adding new districts in areas bordering the zone. During these 13 months over 2,600 acres of heavily rat-infested fields and gulches were cleared and approximately 180,000 burrows were treated and sealed.

Figure 3 shows graphically the effect on the rat catch of rat harborage and food elimination work in the plague zone and adjacent areas, as compared with a previous period when only intensive poisoning was carried out.

SPECIAL PROBLEMS

One important factor in the plague-eradicative work on this island has been the determination of effective measures for controlling rat harborages in rock piles and rock fences, particularly in the vicinity of buildings, where some food is always available. There is a great deal of volcanic and other rock in practically all parts of the island, and in clearing fields for cultivation it has been necessary to remove the rock; in most cases it has been either piled up in various places or used to build rock walls or fences. In traveling through central Maui these rock piles and walls are common sights and can be seen in cane, pineapple, and other fields, the location having been determined by the shortest haul. They are favorite places for setting traps when near any kind of a food supply, as they offer excellent protection to the rat.

The removal of all of this rock from the plague zone was not practicable on account of economic considerations. It was believed essential, however, to remove it from the immediate vicinity of some of the camps in the Paia region, and this was done. Over 25,000 tons of rock were removed from these camps and taken to an uninhabited location along a railroad right-of-way, where it is proposed to pick it up later and crush it for building purposes. This work was simplified by using a cane loader and laying a portable railroad track into the camps. In all other sections it was decided to treat the rock piles and walls about once a month with calcium cyanide dust; and although no dead rats have ever been recovered by this treatment, the trappers find that they are unable to traps rats at these places for some time after treatment, even where some were trapped regularly just prior to treatment.

The apparent success of the cyanide treatment of rock piles and walls compared with its failure in the burrows is probably due to the fact that enough moisture is retained in the rock to generate the gas, whereas burrows probably dry out shortly after the covering is removed.

In view of the fact that approximately 72 percent of the population of the island is located in Central Maui, and since a general survey indicated that buildings were far from satisfactory from a ratproof standpoint, it was believed essential to carry on a ratproofing campaign concurrently with the other work. Many of the camps were in excellent condition; others were equally as poor. Two sanitary inspectors were employed to make a survey of buildings and premises in the plague zone and surrounding areas, and complete reports were made on a specially prepared inspection report form and the owner was notified of required corrections on a specially prepared noncompliance form. Good results were generally obtained in the absence of

regulations, owing principally to the fact that most of the property involved was owned by the plantations; but in some instances it was necessary to send out a wrecking crew to remove rat harborages in buildings. Ratproofing regulations have recently been prepared for adoption by the Territorial board of health.

In Paia many camp laborers were raising pigs in close proximity to the camps, and in pens which generally afforded excellent rat harborage and food. This problem was solved when the plantation company built concrete ratproof pigpens and rented stalls to the employees at a nominal sum per month.

Work of ratproofing the piers was carried out by the Territorial Board of Harbor Commissioners. This consisted of filling in the arches between the pier pilings with concrete from the shore outward to such a distance that even at low water it would be impossible for rats to find their way over dry land to the areas under the pier and shed floors.

A part of the work of the inspector which has required considerable time is the checking of shipments of vegetables from the plague region to see that rats are not shipped in bags or boxes of vegetables.

The practice in the past has been to pack or sack the vegetables, particularly cabbages, the day before they are brought in trucks to the port of Kahului for shipment by steamer to Honolulu and elsewhere. In one case a rat was found in a bag of cabbages at the dock, apparently brought down from the farm. Shippers are now required to pack vegetables the same day that they are shipped, thus reducing the possibility of shipping rats in the cargo.

Sanitary inspections are also made of ships and outgoing cargo at the port of Kahului. The quarantine officer of the United States Public Health Service is furnished with a statement in each case showing that all cargo loaded was inspected and, if of rat-attractive or rat-harboring nature, was either found to be free from rat infestation or was deratized prior to loading. Notation is also made regarding the sanitary conditions at the wharf, the distance from the last plague focus found, the means of communication between the focus and the port, and the safeguards adopted with respect to the vessel itself while in port.

The shooting of rats from nests in algaroba trees was found to be effective in reducing the tree population temporarily; but in order to get permanent results it was necessary to clear the forests of underbrush in conjunction with the shooting. This work was carried out systematically by a group of laborers obtained from the Federal Emergency Relief Administration, and the tree population has been practically eliminated.

MISCELLANEOUS

In the laboratory all rats are examined macroscopically, and those that are suspicious for plague are examined microscopically; in addition tissue inoculations are made into guinea pigs or white rats. Material from not more than 10 rats is used for inoculating one animal, and two inoculations are made per day, one using rats from the port of Kahului and the other using rats caught in one of the districts in the Makawao area. Inoculation is made by shaving the belly of the animal until serum is obtained and the material is thoroughly rubbed into the skin by back and forth strokes with a spatula. Inoculated animals that do not die by the end of the seventh day are killed and examined.

During the latter part of 1935 plans were prepared for new office and laboratory buildings and these were completed before the end of the year. Up to that time laboratory work had been conducted in an old frame building which had been abandoned as a jail. The new buildings consist of two units, one of which contains the laboratory and office and the other the animal room, storeroom, and garage. Plans have recently been prepared for an incinerator at the station, and when this is built there will be excellent facilities for carrying on routine laboratory work. The buildings are located in a fenced enclosure in a pasture just outside the limits of the town of Kahului and were paid for out of funds of the quarantine tax fund commission of the Maui Chamber of Commerce.

The cost of the campaign has not been great compared with results obtained. The total amount expended during the calendar year 1935 was approximately $122,000, of which about $55,000 was furnished by the Federal Emergency Relief Administration and over $30,000 by plantations. Approximately 93 percent of the total amount was spent for labor and salaries.

Beginning January 1, 1936, an allotment of $35,000 was made available by the Federal Government for a rat-abatement project on the Island of Maui, which is being spent at the rate of about $3,000 per month and is being used entirely to hire labor. Many of the men paid out of this fund were taken over from the Federal Emergency Relief Administration and placed on a full-time basis. Total expenditures of the plague campaign during the first 3 months of 1936 average $14,000 per month, 35 percent of which was obtained locally and the remainder from the Federal Government. By the end of March, however, the work had progressed to a point where it was possible to begin reducing the force.

After the practically rat-free region in the Makawao area has been widened according to present plans, there should be every reason to believe that the disease has been eradicated. However, from the

standpoint of possible reinfection, it is essential that work of improving sanitary conditions and ratproofing buildings be continued, particularly in Paia and Kahului. It is also important that a complete program be laid out for the town of Wailuku on account of its proximity to Kahului.

ACKNOWLEDGMENTS

The success of this work has been due in large measure to the close cooperation and valuable assistance rendered by Dr. F. E. Trotter, president and executive officer of the Territorial Board of Health, and to Dr. N. E. Wayson, senior surgeon, of the United States Public Health Service, who made confirmatory diagnoses of a number of rodent plague cases and gave freely of his time and valuable advice concerning the work in general.

PARALYTIC AND NONPARALYTIC (PREPARALYTIC) POLIOMYELITIS

Notification has been received from the Commissioner of Public Health of the State of Tennessee that, effective October 20, 1936, the number of cases of the preparalytic type of poliomyelitis, which are included in the total reported for that disease, will be stated in each weekly report.

The Public Health Service believes that this is a commendable step.

The cases of preparalytic, or nonparalytic, poliomyelitis are nonfatal cases of poliomyelitis which have not shown definite local muscular weakness. On account of variability and uncertainty in the recognition of these cases, it is believed that for recording and comparing the intensity of spread of poliomyelitis only paralytic cases should be counted, and where such a distinction is possible this rule will be followed in the PUBLIC HEALTH REPORTS. Any notable number of nonparalytic cases will be reported separately. This action is not intended to minimize the importance of the preparalytic or nonparalytic case from the point of view of the spread of the disease or the necessity for medical care.

Incidentally, the Department of Public Health of Massachusetts instituted this classification in reporting poliomyelitis cases at the beginning of the present year.

COURT DECISIONS ON PUBLIC HEALTH

Damages awarded for injuries resulting from the sale of unwholesome food.—(Ohio Supreme Court; *Great Atlantic & Pacific Tea Co.* v. *Hughes*, 3 N. E. (2d) 415; decided July 15, 1936.) The plaintiff purchased some pork sausage from one of the defendant's retail

stores after being assured that it was strictly fresh. Soon after the purchase she ate some of the sausage after frying it thoroughly. She subsequently became ill, which illness it appeared resulted from the eating of the sausage. In an action for damages against the defendant company, judgment was rendered for the plaintiff. On appeal to the supreme court, this judgment was affirmed. In reference to an Ohio statute prohibiting the sale of "diseased, corrupted, adulterated or unwholesome provisions without making the condition thereof known to the buyer", it was said: "It must be conceded that unwholesomeness is not a quality to be attributed to food just because it 'disagrees' with the person eating it, as the resulting effect is ordinarily stated. The language of the statute contemplates that the unwholesomeness prescribed shall consist of a diseased, corrupted, adulterated, or other condition having the effect of rendering such food deleterious to the health of normal persons generally."

Law prohibiting the sale of "filled milk" held void.—(Nebraska Supreme Court; *Carolene Products Co.* v. *Banning et al.*, 268 N. W. 313; decided July 8, 1936.) A law of Nebraska prohibited the sale or exchange of any "milk, cream, skim milk, buttermilk, condensed or evaporated milk, powdered milk, condensed skim milk, or any of the fluid derivatives of any of them, to which has been added any fat or oil other than milk fat, either under the name of said products or articles or the derivatives thereof or under any fictitious or trade name whatsoever." An action was brought by the plaintiff, a company engaged in selling "filled milk" products, to secure an injunction to restrain the defendants from enforcing such law. The supreme court, after finding that "filled milk" was a nutritious and healthful food and in no way deleterious to health in its ordinary use, held the law to be "unreasonable and arbitrary and violative of the fourteenth amendment of the United States Constitution and of section 3, art. 1, of the Constitution of Nebraska."

DEATHS DURING WEEK ENDED OCTOBER 17, 1936

[From the Weekly Health Index issued by the Bureau of the Census, Department of Commerce]

	Week ended Oct. 17, 1936	Corresponding week 1935
Data from 86 large cities of the United States:		
Total deaths	7,798	7,866
Deaths per 1,000 population, annual basis	10.9	11.0
Deaths under 1 year of age	556	497
Deaths under 1 year of age per 1,000 estimated live births	50	45
Deaths per 1,000 population, annual basis, first 42 weeks of year	12.1	11.4
Data from industrial insurance companies:		
Policies in force	68,617,638	67,783,476
Number of death claims	9,933	11,498
Death claims per 1,000 policies in force, annual rate	7.6	8.8
Death claims per 1,000 policies, first 42 weeks of year, annual rate	9.8	9.7

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers

Reports for Weeks Ended Oct. 24, 1936, and Oct. 26, 1935

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Oct. 24, 1936, and Oct. 26, 1935

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935
New England States:								
Maine	6	---	---	---	14	45	0	0
New Hampshire	1	---	---	---	---	---	1	0
Vermont	---	3	---	---	---	32	0	0
Massachusetts	3	11	---	---	47	53	4	5
Rhode Island	---	---	---	---	96	4	0	0
Connecticut	2	6	---	---	8	58	0	0
Middle Atlantic States:								
New York	14	34	[1] 7	[1] 7	52	234	7	6
New Jersey	20	20	7	3	41	23	2	0
Pennsylvania	23	49	---	---	29	53	6	4
East North Central States:								
Ohio	34	95	8	9	5	58	5	3
Indiana	35	99	10	27	2	6	3	3
Illinois	32	84	6	16	17	20	3	5
Michigan	22	8	2	3	20	22	2	1
Wisconsin	8	5	16	26	19	55	1	1
West North Central States:								
Minnesota	6	6	---	---	8	14	1	3
Iowa	4	28	---	3	5	2	0	2
Missouri	11	93	130	42	---	26	0	3
North Dakota	---	7	9	---	---	3	0	0
South Dakota	---	4	---	---	1	3	0	0
Nebraska	2	16	---	---	2	40	1	0
Kansas	14	12	---	3	1	3	0	0
South Atlantic States:								
Delaware	5	---	3	---	9	56	0	0
Maryland [2]	15	10	4	6	6	7	0	2
District of Columbia	7	18	2	1	8	---	1	4
Virginia [2]	67	82	---	---	4	15	4	4
West Virginia	42	66	11	16	1	---	1	2
North Carolina [4]	180	124	10	8	13	---	0	2
South Carolina [3]	14	13	114	185	9	6	0	3
Georgia [3]	32	57	---	---	---	---	0	0
Florida [2]	20	24	4	---	2	1	0	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Oct. 24, 1936, and Oct. 26, 1935—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935
East South Central States:								
Kentucky	41	74	12	9	93	65	4	0
Tennessee	68	72	38	22	2	2	0	4
Alabama [2]	34	45	20	36	----	9	2	1
Mississippi [3]	17	38	----	----	----	----	0	0
West South Central States:								
Arkansas	7	22	6	12	----	2	0	0
Louisiana	29	28	23	12	1	13	[5] 1	0
Oklahoma [4]	16	25	40	16	1	2	3	2
Texas [3]	27	170	92	153	4	7	0	3
Mountain States:								
Montana	1	4	12	5	2	10	0	0
Idaho	----	1	8	2	45	----	1	0
Wyoming	1	1	----	----	----	18	0	0
Colorado	10	18	----	----	2	6	2	0
New Mexico	5	7	----	2	35	8	0	0
Arizona	8	8	22	29	11	2	0	0
Utah [2]	----	1	----	----	8	1	1	0
Pacific States:								
Washington	----	3	----	----	5	88	1	1
Oregon	3	1	26	21	6	108	1	1
California	45	65	30	24	46	137	2	2
Total	926	1,555	672	698	680	1,317	60	66
First 43 weeks of year	20,947	27,581	145,393	108,928	273,979	702,700	6,536	4,793

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935
New England States:								
Maine	0	6	10	22	0	0	2	2
New Hampshire	0	0	0	9	0	0	0	0
Vermont	0	4	3	5	0	0	1	1
Massachusetts	4	35	92	120	0	0	1	2
Rhode Island	0	7	17	12	0	0	1	1
Connecticut	2	9	34	44	0	0	5	1
Middle Atlantic States:								
New York	10	45	237	271	0	0	21	10
New Jersey	1	22	37	68	0	0	4	1
Pennsylvania	4	1	233	291	0	0	20	14
East North Central States:								
Ohio	24	0	139	290	0	2	18	25
Indiana	2	4	91	125	0	3	11	7
Illinois	45	12	192	392	2	5	27	20
Michigan	15	14	154	139	0	0	14	9
Wisconsin	0	1	150	275	0	4	6	4
West North Central States:								
Minnesota	1	0	78	151	3	0	1	3
Iowa	4	1	52	82	2	4	6	10
Missouri	3	1	67	143	0	0	19	16
North Dakota	1	1	16	28	1	0	0	8
South Dakota	0	2	43	42	2	12	0	1
Nebraska	2	0	25	35	2	5	0	0
Kansas	8	1	71	88	0	2	5	5
South Atlantic States:								
Delaware	0	0	4	4	0	0	5	4
Maryland [3]	1	1	52	81	0	0	17	16
District of Columbia	0	3	11	13	[7] 0	0	3	2
Virginia [3]	1	4	41	68	0	0	25	29
West Virginia	7	0	76	173	0	0	17	10
North Carolina [4]	2	3	91	135	1	0	10	8
South Carolina [4]	2	1	14	7	0	0	13	5
Georgia [3]	7	0	31	33	1	0	20	13
Florida [3]	1	1	5	7	0	0	3	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Oct. 24, 1936, and Oct. 26, 1935—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935	Week ended Oct. 24, 1936	Week ended Oct. 26, 1935
East South Central States:								
Kentucky	9	7	49	77	0	0	27	12
Tennessee	14	1	64	87	0	0	17	13
Alabama [3]	1	1	27	14	0	0	4	11
Mississippi [1]	2	0	19	16	0	1	9	6
West South Central States:								
Arkansas	4	0	7	18	0	0	5	4
Louisiana	0	8	15	14	0	1	15	33
Oklahoma [6]	2	0	5	21	0	0	13	18
Texas [3]	4	8	22	78	1	0	13	32
Mountain States:								
Montana	0	0	140	52	19	10	6	1
Idaho	0	0	41	20	2	0	8	1
Wyoming	0	0	12	14	1	0	2	0
Colorado	0	0	27	107	1	0	0	8
New Mexico	1	0	20	6	0	0	32	33
Arizona	0	0	15	11	0	0	0	2
Utah [1]	0	1	12	52	0	0	0	0
Pacific States:								
Washington	3	5	34	41	0	31	3	6
Oregon	2	2	25	30	0	0	4	4
California	8	21	153	190	0	0	12	14
Total	197	223	2,756	4,001	38	80	455	420
First 43 weeks of year	3,555	9,838	198,703	202,863	6,425	5,686	12,305	15,351

[1] New York City only.
[2] Week ended earlier than Saturday.
[3] Typhus fever cases, week ended Oct. 24, 1936, 44 cases, as follows: Virginia, 1; South Carolina, 6; Georgia, 22; Florida, 1; Alabama, 8; Texas, 6.
[4] Rocky Mountain spotted fever, week ended Oct. 24, 1936, North Carolina, 1 case.
[5] Delayed report.
[6] Exclusive of Oklahoma City and Tulsa.
[7] Report of 4 cases of smallpox in the District of Columbia, PUBLIC HEALTH REPORTS, Oct. 16, 1936, p. 1448, was an error, no cases of smallpox having occurred.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week:

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
September 1936										
Arizona	1	12	72	4	14	2	2	10	0	7
Florida	4	38	5	78	4	-------	12	16	0	13
Illinois	14	86	18	22	35	-------	240	388	16	111
Kansas	1	29	3	3	8	-------	21	119	1	20
Louisiana	4	58	47	199	4	4	8	18	0	107
Mississippi	1	90	640	7,897	49	342	28	39	-------	96
New York	24	62	-------	8	195	-------	49	460	0	85
Oklahoma [1]	6	27	46	110	1	12	4	23	2	60
Oregon	2	3	32	17	12	-------	10	48	2	18
Rhode Island	1	1	-------	-------	9	-------	0	53	0	10
South Dakota	-------	1	10	-------	17	-------	4	47	0	12
Tennessee	18	132	31	341	11	20	80	109	0	136
Texas	6	125	94	3,098	27	13	9	85	1	107
Vermont	-------	-------	-------	-------	9	-------	0	10	0	2
Washington	1	5	9	-------	31	-------	28	85	7	20
Wisconsin	6	18	60	-------	73	-------	20	390	3	9

[1] Exclusive of Oklahoma City and Tulsa.

Summary of monthly reports from States—Continued

September 1936

	Cases
Chicken pox:	
Arizona	15
Florida	3
Illinois	81
Kansas	9
Mississippi	92
New York	221
Oklahoma [1]	1
Oregon	17
Rhode Island	13
South Dakota	9
Tennessee	13
Texas	14
Vermont	17
Washington	101
Wisconsin	235
Dengue:	
Florida	7
Mississippi	6
Dysentery:	
Arizona	24
Florida (bacillary)	4
Illinois (amoebic)	9
Illinois (amoebic carriers)	24
Illinois (bacillary)	29
Kansas (bacillary)	6
Louisiana (amoebic)	17
Louisiana (bacillary)	1
Mississippi (amoebic)	59
Mississippi (bacillary)	647
New York (amoebic)	6
New York (bacillary)	78
Oklahoma [1]	15
Tennessee (amoebic)	3
Tennessee (bacillary)	42
Texas (bacillary)	40
Washington (amoebic)	1
Washington (bacillary)	7
Epidemic encephalitis:	
Arizona	1
Illinois	11
Kansas	2
New York	6
Rhode Island	1
Washington	2
Favus:	
Illinois	1
German measles:	
Arizona	6
Illinois	20
New York	34
Rhode Island	11
Tennessee	1
Washington	11
Wisconsin	28
Hookworm disease:	
Louisiana	6
Mississippi	210
Impetigo contagiosa:	
Kansas	2
Oklahoma [1]	1
Oregon	96
Tennessee	16
Washington	1

September 1936—Continued

	Cases
Lead poisoning:	
Illinois	7
Leprosy:	
Arizona	1
Mumps:	
Arizona	17
Florida	30
Illinois	86
Kansas	46
Louisiana	8
Mississippi	210
Oklahoma [1]	2
Oregon	27
Rhode Island	16
South Dakota	16
Tennessee	15
Texas	74
Vermont	21
Washington	51
Wisconsin	192
Ophthalmia neonatorum:	
Illinois	3
New York	7
Oklahoma [1]	1
Wisconsin	2
Paratyphoid fever:	
Florida	1
Illinois	5
Louisiana	1
New York	9
Oregon	1
Tennessee	2
Texas	13
Washington	1
Puerperal septicemia:	
Mississippi	18
Washington	2
Rabies in animals:	
Illinois	33
Louisiana	27
Mississippi	14
New York [2]	2
Washington	6
Rabies in man:	
Illinois	3
Rocky Mountain spotted fever:	
Illinois	1
Scabies:	
Kansas	1
Oregon	62
Tennessee	3
Washington	5
Septic sore throat:	
Illinois	1
Kansas	1
Louisiana	3
New York	27
Oklahoma [1]	19
Rhode Island	2
Tennessee	7
Washington	1
Wisconsin	2

September 1936—Continued

	Cases
Tetanus:	
Illinois	6
Kansas	1
Louisiana	2
New York	7
Oklahoma [1]	2
Tennessee	2
Trachoma:	
Arizona	26
Illinois	185
Mississippi	5
Oklahoma [1]	16
South Dakota	1
Tennessee	53
Trichinosis:	
Illinois	3
New York	11
Tularaemia:	
Illinois	2
Louisiana	1
Tennessee	2
Texas	1
Wisconsin	1
Typhus fever:	
Florida	11
Louisiana	1
New York	1
Tennessee	1
Texas	42
Undulant fever:	
Arizona	4
Florida	2
Illinois	7
Kansas	5
Louisiana	5
New York	17
Oklahoma [1]	6
Rhode Island	1
Tennessee	3
Texas	5
Vermont	3
Washington	2
Wisconsin	14
Vincent's infection:	
Illinois	16
Kansas	9
New York [2]	53
Oregon	13
Tennessee	9
Whooping cough:	
Arizona	10
Florida	17
Illinois	524
Kansas	41
Louisiana	7
Mississippi	169
New York	1,059
Oklahoma [1]	4
Oregon	62
Rhode Island	75
South Dakota	4
Tennessee	14
Texas	48
Vermont	107
Washington	69
Wisconsin	552

[1] Exclusive of Oklahoma City and Tulsa.
[2] Exclusive of New York City.

WEEKLY REPORTS FROM CITIES

City reports for week ended Oct. 17, 1936

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table. Weekly reports are received from about 700 cities, from which the data are tabulated and filed for reference.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Maine:											
Portland	0	----	0	0	1	0	0	0	0	0	24
New Hampshire:											
Concord	0	----	0	0	2	0	0	1	0	0	18
Nashua	0	----	----	0	----	0	0	----	0	0	----
Vermont:											
Barre	----	----	----	----	----	----	----	----	----	----	----
Burlington	0	----	0	0	0	0	0	0	0	0	9
Rutland	0	----	0	0	1	0	0	0	0	0	7
Massachusetts:											
Boston	1	----	0	2	20	20	0	12	0	73	221
Fall River	0	----	0	0	0	1	0	1	0	0	40
Springfield	0	----	0	0	0	3	0	0	0	2	29
Worcester	0	----	0	7	5	3	0	2	0	13	49
Rhode Island:											
Pawtucket	0	----	0	0	0	0	0	0	0	0	9
Providence	0	----	0	0	8	12	0	1	0	16	58
Connecticut:											
Bridgeport	1	----	0	6	1	0	0	0	1	0	27
Hartford	0	----	0	0	3	5	0	1	0	3	36
New Haven	0	1	1	0	1	0	0	0	0	2	34
New York:											
Buffalo	0	----	0	2	7	18	0	4	0	12	128
New York	11	13	5	28	84	39	0	78	22	73	1,369
Rochester	0	----	0	0	2	1	0	0	1	2	58
Syracuse	0	----	0	0	1	4	0	0	0	15	30
New Jersey:											
Camden	2	----	1	0	1	1	0	2	0	4	34
Newark	1	1	0	1	2	0	0	6	0	14	79
Trenton	0	----	0	0	2	4	0	1	0	0	34
Pennsylvania:											
Philadelphia	2	----	1	3	17	32	0	11	7	97	419
Pittsburgh	3	----	----	----	22	39	0	6	2	16	159
Reading	0	----	1	0	0	4	0	2	0	10	17
Scranton	0	----	----	1	----	2	0	----	0	3	----
Ohio:											
Cincinnati	10	----	2	0	9	10	0	6	0	2	116
Cleveland	3	3	0	0	14	22	0	10	1	20	183
Columbus	8	----	0	0	1	9	0	2	0	1	64
Toledo	0	----	0	0	1	4	0	5	0	15	73
Indiana:											
Anderson	0	----	1	0	3	0	0	0	0	1	12
Fort Wayne	0	----	0	0	4	1	0	0	0	0	22
Indianapolis	2	----	0	0	7	8	0	4	0	4	116
Muncie	1	----	0	0	0	1	0	0	0	0	9
South Bend	0	----	0	0	1	1	0	0	0	6	19
Terre Haute	0	----	0	0	0	4	0	0	0	0	14
Illinois:											
Alton	0	----	0	0	1	4	0	0	0	0	6
Chicago	5	4	1	7	43	60	0	33	3	53	683
Elgin	1	----	0	0	0	0	0	0	0	3	8
Moline	0	----	0	0	0	0	0	0	0	0	5
Springfield	0	----	0	0	1	1	0	0	0	1	20
Michigan:											
Detroit	6	1	1	2	22	40	0	23	0	86	260
Flint	0	----	0	2	3	5	0	0	0	2	16
Grand Rapids	0	----	0	1	1	12	0	0	0	5	32
Wisconsin:											
Kenosha	0	----	0	1	0	4	0	0	0	1	5
Madison	0	----	0	0	0	2	0	0	0	2	21
Milwaukee	1	1	1	2	3	18	0	3	0	34	82
Racine	0	----	0	0	0	1	0	0	0	1	5
Superior	0	----	0	0	0	2	0	0	0	11	4
Minnesota:											
Duluth	0	----	0	2	0	3	0	2	0	0	17
Minneapolis	8	----	1	0	4	7	0	1	0	10	94
St. Paul	0	----	0	3	7	3	0	0	0	3	63
Iowa:											
Cedar Rapids	0	----	----	0	----	2	0	----	0	0	----
Davenport	0	----	----	0	----	1	0	----	0	0	----
Des Moines	0	----	----	0	----	5	0	----	0	0	23
Sioux City	0	----	----	0	----	3	0	----	0	0	----
Waterloo	1	----	----	0	----	4	0	----	0	11	----

City reports for week ended Oct. 17, 1936—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Missouri:											
Kansas City	2	------	0	0	9	13	0	6	0	0	94
St. Joseph	------	------	------	------	------	------	------	------	------	------	------
St. Louis	6	1	1	0	6	11	0	14	3	8	208
North Dakota:											
Fargo	0	------	0	0	0	0	0	0	0	0	3
Grand Forks	0	------	------	0	------	0	0	------	0	0	------
Minot	0	------	0	0	0	1	0	0	0	0	8
South Dakota:											
Aberdeen	0	------	------	1	------	5	0	------	0	0	------
Sioux Falls	0	------	0	0	0	0	0	0	0	0	10
Nebraska:											
Omaha	1	------	0	0	1	8	0	0	0	0	49
Kansas:											
Lawrence	0	------	0	0	0	0	0	0	0	0	9
Topeka	0	------	0	0	1	1	0	0	0	0	20
Wichita	0	------	0	0	7	11	0	0	0	1	30
Delaware:											
Wilmington	0	------	0	0	3	0	0	0	1	1	33
Maryland:											
Baltimore	2	1	0	1	16	10	0	16	0	75	185
Cumberland	0	1	1	1	0	3	0	1	0	0	20
Frederick	0	------	0	0	1	0	0	0	0	0	5
District of Col.:											
Washington	11	------	0	3	14	6	0	14	2	23	168
Virginia:											
Lynchburg	3	------	0	1	0	1	0	0	0	0	8
Norfolk	2	5	0	0	4	1	0	1	0	0	27
Richmond	0	------	2	0	8	2	0	3	0	0	61
Roanoke	0	------	0	0	1	0	0	2	0	0	23
West Virginia:											
Charleston	2	------	0	0	6	1	0	0	1	0	32
Huntington	8	------	------	0	------	3	0	------	0	0	------
Wheeling	0	------	0	0	0	0	0	1	0	1	12
North Carolina:											
Gastonia	2	------	------	0	------	2	0	------	0	0	------
Raleigh	------	------	------	------	------	------	------	------	------	------	------
Wilmington	4	------	0	0	8	1	0	1	1	0	11
Winston-Salem	0	------	0	1	1	1	0	0	0	1	21
South Carolina:											
Charleston	0	5	0	0	9	1	0	3	1	1	23
Columbia	------	------	------	------	------	------	------	------	------	------	------
Florence	0	------	0	0	1	0	0	1	0	0	15
Greenville	1	------	0	0	1	1	0	0	0	0	13
Georgia:											
Atlanta	9	7	1	0	5	5	0	4	0	0	93
Brunswick	0	------	0	0	1	0	0	0	0	0	7
Savannah	3	3	0	0	0	2	0	2	0	4	29
Florida:											
Miami	0	------	3	0	2	0	0	1	0	0	35
Tampa	4	------	0	1	1	1	0	0	0	8	12
Kentucky:											
Ashland	1	------	------	0	------	3	0	------	0	0	------
Covington	0	------	0	0	1	1	0	3	0	0	24
Lexington	0	------	0	0	1	0	0	1	0	0	21
Louisville	0	------	0	0	5	6	0	2	0	30	56
Tennessee:											
Knoxville	3	------	0	1	1	2	0	0	1	0	29
Memphis	3	------	1	0	4	9	0	4	1	4	62
Nashville	2	------	0	0	8	2	0	5	0	0	50
Alabama:											
Birmingham	3	2	0	1	7	3	0	3	1	4	62
Mobile	2	1	0	0	1	0	0	1	0	0	21
Montgomery	1	------	------	0	------	2	0	------	0	0	------
Arkansas:											
Fort Smith	1	------	------	0	0	0	0	------	0	0	------
Little Rock	0	------	0	0	4	0	0	4	0	0	8
Louisiana:											
Lake Charles	0	------	0	0	2	0	0	0	0	0	4
New Orleans	0	1	1	0	8	0	0	4	0	1	153
Shreveport	0	------	0	0	2	0	0	6	0	0	45
Oklahoma:											
Oklahoma City	6	------	0	0	3	2	0	1	0	0	35
Tulsa	0	------	------	0	------	2	0	------	1	0	------

City reports for week ended Oct. 17, 1936—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Texas:											
Dallas	2	1	1	0	6	3	0	1	2	4	62
Fort Worth	1	------	0	3	4	0	0	0	0	0	32
Galveston	0	------	0	0	1	0	0	2	0	0	18
Houston	1	------	0	0	5	3	0	4	0	1	70
San Antonio	0	------	1	0	4	0	0	4	0	0	52
Montana:											
Billings	1	------	0	0	0	0	0	0	0	0	7
Great Falls	0	------	0	1	0	1	1	0	0	0	7
Helena	0	------	0	0	0	0	0	0	0	0	6
Missoula	0	------	0	0	2	1	0	0	0	0	8
Idaho:											
Boise	0	------	0	0	1	0	0	0	0	0	11
Colorado:											
Colorado Springs	0	------	0	0	1	1	0	0	0	0	12
Denver	4	------	1	2	6	5	0	3	0	33	86
Pueblo	1	------	0	0	0	4	0	1	0	0	12
New Mexico:											
Albuquerque	2	------	0	0	0	1	0	3	0	0	8
Utah:											
Salt Lake City	0	------	0	0	2	8	0	0	0	1	47
Nevada:											
Reno	------	------	------	------	------	------	------	------	------	------	------
Washington:											
Seattle	0	------	1	1	9	3	0	1	0	0	84
Spokane	0	2	2	1	4	21	0	2	0	0	37
Tacoma	0	------	0	0	1	1	0	0	0	0	29
Oregon:											
Portland	2	------	0	0	2	4	0	0	0	1	70
Salem	0	------	------	0	------	1	0	------	0	5	------
California:											
Los Angeles	19	7	1	3	11	12	0	25	0	39	312
Sacramento	3	------	0	2	1	16	0	2	1	6	23
San Francisco	1	------	0	0	8	13	0	7	0	18	145

State and city	Meningococcus meningitis		Poliomyelitis cases	State and city	Meningococcus meningitis		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
New Hampshire:				**North Dakota:**			
Concord	0	0	1	Grand Forks	0	0	1
Massachusetts:				**South Dakota:**			
Boston	0	0	1	Sioux Falls	1	1	0
Rhode Island:				**Maryland:**			
Providence	1	0	0	Baltimore	2	0	0
New York:				**Virginia:**			
Buffalo	2	1	0	Richmond	1	0	0
New York	4	3	3	**South Carolina:**			
Rochester	0	0	1	Charleston	0	0	1
Syracuse	0	0	1	**Kentucky:**			
Pennsylvania:				Louisville	1	0	0
Philadelphia	1	0	0	**Tennessee:**			
Ohio:				Knoxville	0	1	2
Cincinnati	3	1	0	Memphis	0	0	3
Cleveland	0	0	1	**Alabama:**			
Toledo	1	0	5	Birmingham	2	0	1
Illinois:				**Oklahoma:**			
Chicago	1	0	18	Oklahoma City	1	0	0
Elgin	0	0	2	Tulsa	0	0	13
Michigan:				**Texas:**			
Detroit	1	0	4	Fort Worth	0	0	1
Minnesota:				**Colorado:**			
Minneapolis	3	0	2	Denver	0	0	1
Iowa:				**California:**			
Davenport	0	0	1	Los Angeles	0	0	5
Des Moines	0	0	1				
Missouri:							
St. Louis	1	0	3				

Epidemic encephalitis.—Cases: New York, 2; Chicago, 1; Milwaukee, 1; Portland, 1; San Francisco, 1.
Pellagra.—Cases: Boston, 1; Norfolk, 1; Atlanta, 1; Savannah, 1; New Orleans, 3.
Typhus fever.—Cases: Atlanta, 3; Tampa, 1; New Orleans, 1.

FOREIGN AND INSULAR

CZECHOSLOVAKIA

Communicable diseases—July 1936.—During the month of July 1936 certain communicable diseases were reported in Czechoslovakia as follows:

Diseases	Cases	Deaths	Diseases	Cases	Deaths
Anthrax	8		Paratyphoid fever	21	
Cerebrospinal meningitis	10	5	Poliomyelitis	51	3
Chicken pox	80		Puerperal fever	28	10
Diphtheria	1,365	99	Scarlet fever	1,706	54
Dysentery	141	15	Trachoma	86	
Influenza	11		Typhoid fever	543	37
Lethargic encephalitis	2	2	Typhus fever	4	
Malaria	285				

IRISH FREE STATE

Vital statistics—Second quarter 1936.—The following statistics for the Irish Free State for the quarter ended June 30, 1936, are taken from the Quarterly Return of Marriages, Births, and Deaths, issued by the Registrar General, and are provisional:

	Number	Rates per 1,000 population		Number	Rates per 1,000 population
Marriages	3,430	4.6	Deaths from—Continued.		
Births	15,040	20.3	Influenza	193	0.26
Total deaths	10,801	14.6	Measles	71	
Deaths under 1 year of age	1,017	[1]	Puerperal septicemia	33	[2] 2.19
Deaths from—			Scarlet fever	43	
Cancer	841	1.13	Tuberculosis (all forms)	955	1.29
Diarrhea and enteritis (under 2 years of age)	78		Typhoid fever	13	
Diphtheria	94		Typhus fever	1	
Dysentery	1		Whooping cough	44	

[1] Deaths under 1 year of age per 1,000 births, 68.
[2] Per 1,000 births.

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CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for October 30, 1936, pages 1518–1531. A similar cumulative table will appear in the PUBLIC HEALTH REPORTS to be issued November 27, 1936, and thereafter, at least for the time being, in the issue published on the last Friday of each month.

Plague

Argentina.—During the period October 1–15, 1936, 1 case of human plague with 1 death was reported in Catamarca Province, and 4 plague infected rats were reported in Buenos Aires, Argentina.

Belgian Congo—Mahagi Territory—Nioka.—On October 21, 1936, 2 suspected cases of plague were reported in Nioka, Mahagi Territory, Belgian Congo.

Hawaii Territory—Island of Hawaii—Hamakua District—Paauhau Sector.—Three rats found October 22, 1936, and 1 rat found October 27, in Paauhau Sector, Hamakua District, Island of Hawaii, Hawaii Territory, have been proved plague infected.

Peru.—During the month of September 1936, 8 cases of plague, including 2 suspected cases, with 1 death were reported in Peru. Plague-infected rats were also reported present in Callao, Peru, and in the port of Salaverry, Peru.

Typhus Fever

Peru.—During the month of July 1936, 268 cases of typhus fever were reported in Peru.

Yellow Fever

Colombia.—During the period August 29 to September 19, 1936, 3 deaths from yellow fever were reported in Colombia.

Dahomey—Bembereke.—From September 21 to 30, 1936, 1 case of yellow fever with 1 death was reported in Bembereke, Dahomey.

Sudan (French)—Katibougou.—On October 4, 1936, 1 case of yellow fever was reported in Katibougou, Sudan (French).